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FOREST RESEARCH IN INDIA & BURMA 1947-48

PART I.—THE FOREST RESEARCH INSTITUTE

Page 7, line 3, *for* ' hald ' *read* ' held '

Page 7, line 6, *for* ' 1926 ' *read* ' 1626 '

Page 8, line 16, *for* ' samplings ' *read* ' saplings '

Page 8, line 18 from bottom, *for* ' retardents ' *read* ' retardants '

Page 8, line 11 from bottom, *for* ' oross ' *read* ' across '

Page 8, line 4 from bottom, *for* ' metal ' *read* ' metals '

Page 8, line 3 from bottom, *for* ' antocatalytic ' *read* ' autocatalytic '

Page 10, line 11 from bottom, *for* ' lectone ' *read* ' lactone '

Page 10, last line, ' *p* ' in ' *putranjiva* ' should be capital

Page 11, para 5, lines 3 & 4, *for* ' elaeosterric ' *read* ' elaeosteric '

Page 15, table 2, last column, in items 5-10 insert 8, 8, 4, 4, 3, 3, respectively

Page 17, sub-para (a), item 5, *for* ' *Caltis tetrandra* ' *read* ' *Celtis tetrandra* '

Page 20, table, last column, item D, *for* ' 143 ' *read* ' 14·3 '

Page 21, table 1, last column, *for* ' Avreage ' *read* ' Average '

Page 21, table 2, last column, *for* ' hight ' *read* ' height '

Page 24, line 5, *for* ' *Pinus caribea* ' *read* ' *Pinus caribaea* '

Page 25, line 14 from bottom, *for* ' car load ' *read* ' cart load '

Page 25, line 2 from bottom, *for* ' W. and W. P. ' *read* ' C.W. & W.P. '

Page 25, last line, *for* ' C.W. ' *read* ' C.W. & W.P. '

Page 26, line 15, *for* ' 290 ' *read* ' 890 '

Page 26, line 17 (Grand Total), *for* ' 11,166 ' *read* ' 11,186 '

Page 30, line 5 from bottom, *for* ' *Salaginella* ' *read* ' *Selaginella* '

Page 31, line 5, *delete* ' the ' *before* ' Tibet '

Page 32, line 11, *for* ' movable ' *read* ' mowable '

Page 36, line 3, *for* ' borer ' *read* ' borers '

Page 36, line 15, *for* ' develop ' *read* ' develops '

Page 39, line 10 from bottom, *for* ' Scaraubacidae ' *read* ' Scarabacidae '

Page 45, line 4, *for* ' courses ' *read* ' classes '

Page 50 line 9 from bottom, *add* ' These ' *before* ' were '

Page 51, line 1, *for* ' Kottayam ' *read* ' Kohayam '

Page 51, line 10, *for* ' seem ' *read* ' seems '

Page 51, line 17, *add* ' Ten ' *before* ' consignments '

Page 61, line 22, *for* ' metal ' *read* ' metals '

Page 63, line 7, *for* ' *Lathyrus sativa* ' *read* ' *Lathyrus sativus* '

Page 71, line 14 from bottom, *for* ' Expert Committee ' *read* ' Experts' Committee '

Page 73, line 21, *for* ' Expert's Committee ' *read* ' Experts' Committee '

Page 73, line 24, for ' Sipur ' *read* ' Sirpur '

Page 75, lines 4 & 5 from bottom, *for* ' extracetion ' *read* ' extraction '

Page 76, top table, item 1, *for* ' 60° 1-50° ' *read* ' 60°-150 ° '

Page 77, last line, *for* ' $C_3H_3N=C=S$ ' *read* ' $C_4H_{10}N=C=S$ '

Page 78, line 3, *for* ' fractions ' *read* ' fraction '

Page 79, table item 1, *for* ' also holic ' *read* ' alcoholic '

Page 80, line 7, *for* ' isomerized ' *read* ' isomeric '

Page 80, para 2, sub-para 1, line 3, *for* ' 0/16 ' *read* ' 0 16 '

Page 83, line 20, *add* ' Forestry ' *after* ' Empire '

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FOREST RESEARCH IN INDIA & BURMA

1947-48

PART I.—THE FOREST RESEARCH INSTITUTE



THE FOREST RESEARCH INSTITUTE, DEHRA DUN

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FOREST RESEARCH IN INDIA & BURMA 1947-48

PART I.—THE FOREST RESEARCH INSTITUTE.

CHAPTER I.

(a) *General.*

The year was marked by two important events *viz.*, (1) Post war re-organisation affecting the internal organisation of the Institute and (2) political developments consequent on the achievement of freedom and the partition of the country in so far as they affected the Institute.

The expansion and re-organisation scheme for the Institute sanctioned earlier, involved the provision of increased laboratory and workshop facilities, addition of modern equipment (especially regarding plywood and composite wood investigations and cellulose and paper research) and recruitment of new staff on a considerable scale in almost all Branches. Almost no progress was made during the year in this connexion. This set-back was largely due to acute shortage in the country of all raw materials for building construction, unavoidable difficulties in obtaining within any reasonable period supplies of machinery and equipment from overseas countries and the unavailability of the right type of qualified men to fill the various posts, apart from the pre-occupation of the Government of India, with other urgent matters such as the plans for partition of the country.

Re-organisation.—However, in May, 1947, the Utilisation Branch which included a number of sections of Forest Products Research was split up in order to allow each of these sections full scope for development. They were accordingly constituted into Branches directly responsible to the President. The new Branches are designated—"Wood Technology", "Wood Working and Timber Mechanics", "Wood Seasoning", "Composite Wood and Wood Preservation" and "Cellulose and Paper". Plans are in hand for the equipment, staff etc., of each of these Branches to be enlarged, as found necessary from war time experience. At the same time, a Publicity and Liaison Branch has also been set up. This Branch has taken over all functions of the late Utilisation Officer not specifically allotted to the other new Branches, and will besides be responsible for developing a library service to the Research Branches, for general publicity for the work and achievements of the Institute, for establishing close liaison with the forest departments and forest industries and for systematic collection of information regarding forest resources. In July, 1947, a Statistical Branch was also established for the purposes of ensuring sound design of experiments and statistical analysis of data obtained from such experiments.

Partition.—Fortunately for the future of Forestry in India, the partition of the country has resulted in no serious change in the organisation of the Forest

Research Institute, which was declared a " unique institution ". Under orders of the Government of India, however, duplicates of specimens which could be spared from (1) the herbarium, (2) the insect collections and (3) the timber collections (of the Wood Technology Branch), were separated and made over to the Pakistan authorities. This involved a considerable amount of work as every specimen in these extensive collections had to be examined to see what could be spared. A considerable amount of labour and time of the entire staff was also taken up by the work of preparing exhaustive lists of the assets of the Institute, for the information of the Partition Council.

Staff.—The partition of the country had the very adverse effect of serious depletion of staff (particularly in the workshops) owing to most of the Muslim staff opting for Pakistan. Even normal work thus received a serious set back, leave alone progress being attempted under the re-organisation and expansion plans. The following officers besides a number of members of the technical and clerical staff left the Institute for Pakistan :—

Mr. Z. Ahmed, Personal Assistant to the President, Mr. Mohd. Yar Khan, Head Assistant, Central Office, Mr. A. H. Khan, Asst. Mycologist, Botany Branch, Mr. A. H. Khan, I. F. S., Forest Entomologist, Entomology Branch, Mr. S. M. Ishaq, Asstt. Wood Seasoning Officer, Wood Seasoning Branch, Mr. Sultan Mohammad, Officer-in-Charge, Wood Working Section, Wood Working and Timber Mechanics Branch, Mr. Mohd. Quyyum, Asst. Chemist, Cellulose and Paper Branch.

The general staff position further deteriorated with the departure of the European officers of the Indian Forest Service—*viz.*, Mr. D. Stewart, President, Dr. A. L. Griffith, Silviculturist, and earlier in the year Mr. J .C. M. Gardner, Forest Entomologist. For one reason or another none of these vacancies were filled by fresh recruitment and work was carried on by readjustments in postings of existing officers and by placing officers in additional charges on a considerable scale.

Proposals (New Items) for sanction of additional posts under the re-organisation scheme were not dealt with by Government till the end of the year and thus no new recruitment could be made either. Thus, the staff position, particularly technical staff of all ranks, was critical in almost all the Branches for a major part of the year.

A change in administration of major significance occurred with the departure in November, 1947 of Mr. D. Stewart, I.F.S. on leave preparatory to retirement, when Shri C. R. Ranganathan, I.F.S., Director of Forest Education, assumed charge as President of the Institute.

To the charge of the newly created Publicity and Liaison Branch, Shri C.A.R. Bhadran, I.F.S. was appointed. He held this post in addition to that of Personal Assistant to the President and subsequently of the Director of Forest Education. Shri M. L. Khanna relieved him of the duties of the Personal Assistant to the President with effect from 3rd January 1948.

Dr. K. R. Nair was appointed Statistician in charge of the newly created Statistical Branch.

Dr. S. Krishna, Bio-chemist, and Shri M. P. Bhargava, Officer-in-charge, Cellulose and Paper Branch, were on deputation for 6 months to the United Kingdom, Europe, Canada and the United States of America to study the latest equipment and methods adopted in Paper and Cellulose industries in those countries. As a result, with the approval of an *ad hoc* Expert Committee, new equipment on a large scale has since been ordered from the United States of America for the Cellulose and Paper Branch.

During their stay in the United Kingdom, Dr. S. Krishna and Shri M. P. Bhargava attended the 5th Empire Forestry Conference 1947, the Centenary Celebrations of the Chemical Society, London, and the International Congress of Pure and Applied Chemistry.

Dr. K. A. Chowdhury, Wood Technologist, was selected as Sectional President, Botany Section, Indian Science Congress, 1948.

Conferences.—An *ad hoc* Committee on plywood, particularly for tea chests, set up at the instance of the Government of India met at the Forest Research Institute in July 1947, and framed revised tentative specifications for plywood, etc. The research officers concerned and the administrative officers of the Institute took a prominent part in these deliberations, which were presided over by the President, (Mr. D. Stewart).

After a lapse of seven years and for the first time after the war ended, the Central Advisory Board on Forest Utilisation met at the Institute in March, 1948. The Board was re-constituted to include all essential non-official interests: this necessitated the omitting of representatives of Provincial Forest Departments (who were consequently represented by the Inspector General of Forests). The meetings of the Board were presided over by Shri B. R. Sen, I.C.S., Secretary, Ministry of Agriculture. As approved by the Board, a 5-year programme of work (commencing 1948-49) was adopted by the various branches of the Institute instead of the previous triennial programmes. The meeting was also attended by the Director, Indian Standards Institution.

Work accomplished.—In spite of the serious set-back during the year as regards both staff and equipment, the work of the Institute during the year was maintained up to the mark.

Particular attention may be drawn to the series of leaflets on "Efficiency of enumerations" issued by the Silviculture Branch. This Branch also completed preparation for the Press of the revised Statistical Code "The Tree and Crop Measurement Manual". The Mycologist continued his pathological survey of Indian forests, particularly with reference to sal diseases. The Entomology Branch was able to indicate simple adjustments in forest management in evergreen and sal forests to reduce the incidence of borers in freshly felled timber and ballies. The Wood Technology Branch brought out a helpful publication on "Some More Commercial Timbers of India." The wood Technologist was also investigating interesting archaeological specimens from the Harappa excavations. The Wood Seasoning and the Wood Working and Timber Mechanics Branches were actively interested in the development of Indian woods for accessories used in jute, cotton, and other textile mills. The Timber Testing Section was able to advise in favour of the adoption of the 12-batten type of tea chests

with reduction in the thickness in the plywood used to result in a 10-12 per cent saving of timber requirements for packing tea. The Composite Wood and Wood Preservation Branch obtained encouraging results in experiment on—

(1) the production of pentachlorophenol in one stage, (2) the use of cashew-nut shell oil, whole blood, and seeds of *Lathyrus sativus* respectively for the production of adhesives, (3) the production of boards from wood waste and bamboo mats, using small quantities of binders, and (4) the thermal setting of adhesives. The Cellulose and Paper Branch took a stride forward towards the manufacture of newsprint in India, with the commercial tests on paper made from a 70 : 30 mixture of mechanical pulp from *Broussonetia papyrifera* and chemical bleached bamboo pulp.

Other important aspects of the work undertaken during the year include (1) the helpful attention and expert advice given to innumerable enquirers on all matters connected with forests and forest products received from all parts of the country, (2) the identifications carried out in the Botany, Entomology and Wood Technology Branches on behalf of scientists, Forest departments, Defence and Central Government departments and Commercial and industrial interests, and (3) the technical tests carried out (usually for the general information of the public) on proprietory preparations such as insecticides, wood preservatives, wood adhesives etc.

The summaries appended below will give a fuller idea of the work done by individual Branches.

(*b*) *Summaries of Branches.*

SILVICULTURE BRANCH.

Experimental Silviculture.

Natural Regeneration.—It was a good seed year for *Terminalia tomentosa* but a poor one for teak. Seed tests were made with 65 species, including six new additions.

Storage of juniper seed in a pit in the earth 2 feet below ground level improved the germination percentage considerably.

Investigations were continued relating to phenology, seasonal height growth of trees, seedling development, inheritance of characters, changes in soil and ground vegetation, afforestation and the effect of early pruning. Data relating to the two first investigations are being already made use of in practical silviculture.

Artificial Regeneration.—The rainfall at New Forest for the 1947 calendar year was 89·77 inches (93·87 inches). The usual experiments relating to methods of stocking etc., were conducted. Stump planting of *Dalbergia sissoo* by a fortnight's delay after 10th July was found to cause a significant loss in height of shoots. Sowings were found to give the best results in the case of *Terminalia tomentosa* and stump planting in the case of *Markhamia platycalyx*. The yield of tung fruits was found to be 9·29-1·88 seers for *Alcurites fordii* and 7·4 0·59 seers for *A. montana* per tree in the 16th year of the plantation. The fruits of the former ripen and fall simultaneously, while those of the latter fall intermittently.

F.R.I. Estate Working Plan.—Revenue from the management of the F.R.I. estate under the sanctioned working plan continued to maintain improvement over past unregulated working.

Forest Statistics.—Routine sample plot computations were done for 260 plots (372).

The statistical cod was completely revised and submitted for printing as the "Tree and Crop Measurement Manual for India." Enumeration data from south Chanda and growth data from Nagpur, Wardha, Hoshangabad and Nimar divisions of the Central Provinces and Berar were computed. Statistical portions of the Manual of Indian Silviculture were brought up-to-date. Two officers were trained and 23(16) sample plots in the U.P. were measured.

Miscellaneous.—Routine enquiries and examination of working plans were attended to.

Abstracts of Indian forest literature were prepared as usual, as also supplements to list of books added to all libraries of the Forest Research Intitute.

Work in the photographic section was continued and kept up-to-date.

BOTANY BRANCH

The conditions under which the work had to be carried out during the year were again difficult. Owing to further shortage of staff, especially after the partition of the country bare maintenance and routine work could be kept up and research work came practically to a standstill. Considerable time of the already depleted staff was taken up in calculating assets etc., of the branch and in sorting duplicate specimens from the herbarium and the mycological collections for Pakistan.

Inspite of all the above difficulties, long term problems in the Mycology Section were not lost sight of. Tests were carried out on 36 Indian wood rotting fungi, (including those attacking Ascu treated woods). The predisposing causes for formation of Gauj in sal were studied, the data incorporated; and work on the paper on sal diseases is in progress.

Pathological survey and cultural studies on seven fungi attacking coniferous timbers were carried out.

The routine work of Mycological Section included lectures in Mycology and Pathology to the Indian Forest College students maintenance of stock cultures, herbarium and museum, collection of photographs, coloured plates and lantern slides, tours to various forests to collect specimens and isolation of new fungi from diseased forest trees, examination of seeds for infection, and dealing with the enquiries from various forest officers and Branches of the Forest Research Institute regarding the fungus diseases of trees and defects in woods. A set of Mycological specimens was supplied to Central College of Agriculture, New Delhi.

In the Systematic Section 1,400 specimens were added to the herbarium. The more important acquisitions were from Sikkim, Tibet, various parts of Orissa, Eastern States and a consignment of about 255 specimens received in exchange from the Director, Botanic Garden, Singapore.

Over 2,000 specimens were sent out on loan for purposes of study to various research workers in India and abroad.

A large number of specimens received from the various provincial forest and agricultural departments, educational institutions, commercial firms and others were identified. A variety of seeds was supplied to various forest officers and to those correspondents in India and abroad with whom exchange relations exist.

Work in the Botanic Garden and Arboretum made steady progress and plants and cuttings were distributed to various correspondents.

A large number of enquiries covering a wide field of botanical subjects was received and dealt with.

Four papers by Mr. M. B. Raizada and Dr. N. L. Bor were published.

ENTOMOLOGY BRANCH.

The forest departments in the country have shown considerable interest in the possibilities of preventing insect damage to newly felled timbers by simple adjustments or managements. A small field party is working in this connection in West Kanara Forest Division, Bombay since December, 1947.

Results obtained from experiments with sal ballies show that for hot weather fellings, it is not safe to keep ballies with or without bark in the forest shade, while reasonable protection from insect attack is afforded if ballies on felling are kept out in the open and debarked three months later. For monsoon fellings, ballies should not be left in the forest shade either with or without bark, but if kept in the open and debarked after three months ballies can be protected from insect attack. For post monsoon fellings, ballies should be debarked at once and kept in the forest shade. If kept in the open they should be debarked after two months as a measure of protection. It is not advisable to leave winter felling of ballies in the forest shade, but they can safely be kept in the open and debarked after 5 months.

With the recommendations of the Central Advisory Board the sphere of activity of the Forest Entomologist has greatly increased and several co-operative lines of work have been indicated.

Small scale experiments with D.D.T. emulsions, Gammaxene and D.D.T. proprietary fluids have been conducted and encouraging results have been obtained. Large scale experiments are projected, in collaboration with Wood Seasoning, Composite Wood and Wood Preservation, and Wood Technology Branches.

Natural depletion of starch in felled bamboo culms was further examined under Dehra Dun conditions.

Attack of Gymnogryllus humaralis on *Casuarina equisetifolia* is under investigation both in the field and in the Dehra Dun Insectary.

The systematic section maintained contacts with specialists outside India. The main reference collection was maintained in good conditions.

WOOD TECHNOLOGY BRANCH

Dr. K. A. Chowdhury presided over the deliberations of the Botanical Section, Indian Science Congress held at Patna in January, 1948.

The Wood Technology Branch was busy with enquiries on the identification of commercial timbers. These came from Government Departments as well as from commercial firms. During the year 1926 specimens were identified.

The Director-General of Archaeology in India asked for help from this Branch in determining the identity of a number of wood specimens collected from old excavations like Harappa.

Considerable work was done in making preliminary studies of some timbers of broad-leaved species with a view to finding out their possible suitability for mechanical pulp.

WOOD WORKING AND TIMBER MECHANICS BRANCH

Timber Testing Section.—Considerable work was done on plywood tea-chests of Indian manufacture. Comparative tests were made on eight and twelve batten type and on tea-chests with 12 battens but made of thinner plywood. The utilisation of the thinner plywood would result in a saving of about 10 per cent in wood required for tea-chest manufacture.

A number of species were also tested for determining their fundamental strength properties. In all, about 13,000 mechanical tests and about 32,000 physical determinations were made during the year.

Wood Working Section.—Considerable progress was made in the manufacture of jute mill bobbins by—(1) the introduction of 3-ply ends, (2) proper seasoning in the form of blanks, and (3) laying down standards. Other important items investigated were (1) a combined waxing and dyeing treatment for pencil woods, (2) hockey sticks of laminated construction, (3) timbers for hockey sticks in solid wood, (4) designs for plywood chairs, (5) woods for penholders etc.

Staff.—The Staff of the Branch was seriously depleted on account of a large number of skilled workers having opted for Pakistan. The Wood Workshops remained without an Officer-in-charge.

WOOD SEASONING BRANCH

Air and kiln drying studies were carried out on several commercially important but refractory timbers. The rapid kiln drying behaviour of a few packing case woods was also studied. Blue prints of seasoning kilns were supplied to a number of enquirers during the year, including the Conservator of Forests, Colombo, (Ceylon), and Messrs. British American Tobacco Co., Batavia, (Java). An internal fan kiln for seasoning shuttle blocks and a hot air room for the conditioning of semi-finished shuttles were designed for a Bombay shuttle manufacturing firm.

The best method of seasoning bobbin timbers was studied. Damage to wood due to splitting and cracking was found to be least if the wood was seasoned in the form of rough turned prebored bobbin blocks.

Tests to study the effect of girdling (standing trees) on seasoning behaviour of the wood were completed on one set of trees, and the tests on another set of trees were started.

Experiments on the seasoning and suitability of Indian woods for textile and jute mill accessories were continued. Reports on bobbins with reference to manufacturing tests of certain species of woods were received. Service tests on pick arm material of some Indian woods were completed. Work was continued on the bending of wood and the softening of timber for pencil slats. Service tests on whisky maturing vats made of Indian woods were completed.

Tests were carried out to study the retention of shape and size by wood when exposed to varying atmospheric humidity conditions. Work on the effect of corrosive chemicals on wood was continued. The moisture proofing efficiency of certain paints was also studied.

A number of persons were trained in the technique of seasoning.

COMPOSITE WOOD AND WOOD PRESERVATION BRANCH

Preservatives.—Examination of rail samplings treated with different varieties of creosote and installed in the test yards was continued and the data collected during the past 8 years on creosote analysed for publication. Penta-chlorophenol was produced in a pilot plant by a one stage process; with encouraging results.

Treating Processes.—A large scale experiment on the treatment of green *Terminalia tomentosa* sleepers was undertaken. Schedules were studied for the open tank treatment of (army) timbers for affording temporary protection. Vapour conditioning of green *Dichopsis elliptica*, *Albizzia procera*, *Zanthoxylum rhetsa* and *Cedrela toona* was also tried.

Fire Resistance.—The mechanism of action of fire retardents was studied both from the chemical and physical aspects.

Physical and Physico-chemical Properties of Wood and Composite Wood.—Work on permeability of wood was continued and the influence of the absolute pressure of the incoming gas on permeability investigated. Work on the movement of ions through wood was undertaken. The elastic properties of plywood of various species was investigated by vibrational methods. The ratio of the elastic constants along the grain to cross the grain was highest (about 31) with *Terminalia belerica* plywood. The influence of direction of grain was not highly significant with rigidity. In tests on the damping capacity of wood and composite wood, *sissoo* and laurel showed high coefficients while *pidauk* and *chickrassy* had low coefficients. The penetration of heat in various timbers exposed to infra red radiation was found to depend not only on density and colour of the timber but also on other factors.

Corrosion of Metals by Wood.—Corrosion of metal by wood was found to be autocatalytic in nature and to increase at elevated temperatures.

Adhesives, Laminated Wood etc.—Experiments were continued for the production of satisfactory (plywood) adhesives from cashew nut shell liquid and from

whole blood (dried). Work on the proteins of *Lathyrus sativus* and leaves of trees was also initiated. U. F. and other adhesives were subjected to storage trials.

Various methods were tried to accelerate the setting of adhesives. The low voltage method of strip heating was adapted for use with phenolic laminates as well as for P. F. bonded plywood, —H.F. being used for production of the P.F. bonded plywood. An open tank process of curing resin, bonded laminates was also developed with encouraging results. Work on laminated and other forms of improved wood was also undertaken.

Boards etc.—Saw dust boards were developed with very good properties, from saw dust and a small quantity of various binders. Boards suitable for building and other purposes were also developed from bamboo mats and saw dust.

CELLULOSE AND PAPER BRANCH.

Investigations have been carried out on the production of newsprint-quality papers, using mechanical pulp from—(*a*) *Broussonetia papyrifera* and (*b*) *Sterculia companulata* and *Sterculia alata* in admixture with bleached bamboo pulp. *Broussonetia papyrifera* mechanical pulp and bleached bamboo pulp were prepared in bulk quantities and converted into reels of newsprint quality papers at the Shree Gopal Paper Mills, Abdullapur. The reels were subjected to a printing trial on a high speed rotary press at the Statesman Press, New Delhi. The general behaviour of the paper was reported to be good. Further investigations are in progress to overcome some of the flaws observed during the printing trial.

Investigations on cotton wastes from Textile Mills show that these wastes are excellent sources of raw materials for use in the manufacture of superior qualities of paper.

Experiments on *sabai* grass (*Eulaliopsis binata*) from the Saharanpur Forest Division have been carried out with a view to finding out the causes of low yield of paper from the grass and the advantages of digesting grass cut into small pieces.

Nearly 14 tons of papers of different kinds, boards etc., were supplied for printing the Institute publications and to the various offices of the Institute and Colleges.

II. The following investigations were handled in the laboratory: —

1. Kraft pulp from *Pinus longifolia* (*chir*).
2. Recovery of Magnesia from sulphite spent liquor.
3. Stability of drawing papers.
4. Analysis of teak wood.
5. Suitability of certain broad leaved species of woods for paper making.
6. Analysis of limestones.
7. Mechanical and semi-chemical pulp from *Acacia decurrens*.

8. Digestions of Manilla and sisal hemps and carca fibre.

9. Strength test and chemical analysis of various samples of pulps and papers ; and

10. Miscellaneous enquiries.

III. The Officer-in-charge, Cellulose and Paper Branch was on deputation tour abroad for nearly six months, visiting Sweden, Norway, United Kingdom, Canada and the United States in connection with the reorganization of the Branch. His proposals for procurement of pilot plants and laboratory equipment embodied in his report were scrutinized by the Experts Committee and passed with certain amendments. The Advisory Committee of the Indian Paper Industry as well as the Central Board of Forest Utilisation have also endorsed the findings of the Experts Committee, which have since been sub mitted to the Government for sanction.

IV. Meetings of the Advisory Committee of the Indian Paper Industry and the Technical Sub-Committee were held in Calcutta in February 1948 to discuss the programme of work for the year 1948-49, and to pass the accounts for the year 1947-48.

V. Four apprentices from the Paper Mills completed their course of training during the year and two fresh ones joined the Branch for training.

VI. Both the Indian Paper Makers' Association and the Paper Mills Association have decided to revive the voluntary contribution to the Institute with effect from the 1st October, 1947.

VII. Three publications (Indian Forest Bulletins Nos. 127, 128 and 134) were brought out during the year.

VIII. The staff during the year was considerably depleted due to two chemists opting for Pakistan, one being abroad throughout the year as a Government Scholar, and the Officer-in-charge, being on foreign tour for nearly half the year.

CHEMISTRY AND MINOR FOREST PRODUCTS BRANCH

The essential oil obtained from the *roots of Saussurea lappa* by solvent extraction method has been fractionated under reduced pressure and the constants for these fractions have been determined. Along with the oil a solid lactone has also been obtained, and the latter is under investigation.

Berries of *Juniperus macropoda* Boiss, and *Juniperus squamata* Buch.—Ham. from Tehri-Garhwal have been steam-distilled and the physical constants of the oils determined.

Cultivation of a camphor-yielding species of *Ocimum* has been continued. In order to ascertain the effect of different manurial treatments, 25 plots have been statistically treated with superphosphate, ammonium sulphate, farmyard manure and NPK mixture.

From the steam volatile oil (yield 0·5 per cent) of the moist kernels of *putranjiva roxburghii* Wall, three mustard oils, namely *iso* propyl, *sec*-butyl,

and phenyl-*iso*thiocyanate have been identified. The characteristic "mustard" smell of the moist kernels is due to the *iso*propyl and *sec*-butyl mustard oils which form the major constituents of the volatile oil.

Castor oil distillate was found to consist of 40 per cent undecylenic acid, 25 per cent heptaldehyde, 30 per cent other neutral compounds and 5 per cent moisture. Preliminary experiments with heptaldehyde have already yielded a higher aromatic aldehyde of jasmine odour.

The maximum yield of oleoresin from the gum-oleoresin (size of pieces 1/4") of *Boswellia serrata* Roxb., when expressed in a perforated vessel at 120°C. for 4 hours under a load of 1½ lb. per sq. in., was 80 per cent of that present. The oleoresin was found to possess the consistency and transparency of Canada balsam and could be used for mounting slides.

The resin from *Altingia excelsa*, Noronha, has been considered similar to gum rasamala or styrax or storax from *Liquidambar orientalis* Mill. On investigation it was, however, found that it did not resemble styrax or storax of U.S.P. or B.P. The resin might serve as a substitute for a softer type of resin, like gum mastic, in varnishes.

Mallotus philippinensis Muell. Arg.—The solid acids separated from the total fatty acids of the saponified oil by Twitchells lead—salt-alcohol method were found to consist mostly of C_{18} polyethenoid acid of the type of elaeosterric acid and its oxyderivative.

The term "jellose" has been suggested for the poly-saccharide isolated from tamarind seed kernels, since it does not strictly come under the class of pectins. When subjected to fermentative degradation the jellose yields a hexasaccharide composed of xylose, galactose and glucose in the molecular ratio of 2 : 1 : 3.

The tamarind-seed coat contains 16 to 18 per cent of a tanstuff belonging to the catechol class and 10 to 12 per cent of phlobatannin. The acetyl and methyl derivatives of the latter have been prepared.

Asparagus filicinus Buch.—Ham. The root powder, which swells up enormously in water, can be used in calico-printing, in bulk-sizing in combination with tamarind kernel powder and in the finishing of textiles. The constituting mucilage is composed of glucose and mannose with a small amount of uronic acid.

The variation in tannin content of the bark of *Cassia auriculata*, which is an important tanning material, is not marked during different periods. The bark could, therefore, be collected during the growing season (summer) of the plant when the debarking operation is comparatively easier than in the winter.

The seeds of *Strychnos nux-vomica*, stored in a gunny bag for 16 years, have shown no loss in the total alkaloidal and strychnine contents. This is contrary to the common trade belief.

Four series of the monograph on "Aromatic plants of India" have been published. The first volume of the monograph on "Poisonous plants of India" has been completed and it is hoped that it will be out shortly.

MIOFRIDDas.

STATISTICAL BRANCH

The Statistical Branch was brought into existence with effect from 1st August, 1947, with the object of making available to the other Branches of the Institute and to Provincial Forest Research Officers expert advice for the planning of their experiments on statistically sound lines and to assist them in the statistical analysis and interpretation of the data of such experiments.

Dr. A. L. Griffith, I.F.S., Silviculturist, Forest Research Institute, was in charge of the Branch in addition to his duties until 28th October, 1947, when Dr. K. R. Nair, M.A., M.Sc., Ph.D, joined the Institute as Statistician. Besides him, the technical staff consisted of 2 head computors and 5 computors during the year.

The Branch gave advice on design of experiments to—

(1) Chemistry and Minor Forest Products Branch. (2) Entomology Branch, (3) Silviculture Branch, (4) Timber Testing Section, (5) Silviculture Branch, (6) Silviculturist, Central Provinces and Berar, and (7) The Silviculturist, United Provinces.

The Branch did statistical analyses of data of a number of investigations of the (1) Silviculture Branch, (2) the Timber Testing Section, and (3) the Composite Wood and Wood Preservation Branch.

At a meeting called by the President, Forest Research Institute and Colleges, the Statistician gave a talk to the Research Officers of the Forest Research Institute explaining the role of statistics in experimental research.

The Statistician attended the conference on Standardization and Quality Control held in Calcutta in February, 1948, as a representative of the Forest Research Institute.

PUBLICITY AND LIAISON BRANCH

The Branch came into existence on 20th May, 1947, with the re-organisation of the late Utilisation Branch. Such over-all and other functions of the Utilisation Officer as were not specifically allotted to the various new Branch Officers became the responsibility of the Publicity and Liaison Officer. The Branch is also to develop into a general service Branch for the rest of the Institute and Colleges, particularly with reference to library work. The Branch is also entrusted with all work connected with the publications of the Forest Research Institute and Colleges. Not the least of its functions will be to bring, more effectively than up-to-date, the work and achievements of the Institute to the notice of the public, the industries and the business community. By personal contacts the Publicity and Liaison Officer is also expected to maintain close liaison between the Institute and the Forest Departments in the country. The Branch will also undertake the collection of statistics of forest resources of the country.

The Publicity and Liaison Officer functions as the Secretary of the Central Advisory Board on Forest Utilisation.

The working of the Branch has been badly handicapped for want of staff from the very beginning. The charge of the Branch has been held all along as additional to other work : and not even an Assistant Publicity and Liaison Officer has been sanctioned up-to-date. None of the other technical staff proposed has been sanctioned up-to-date. While the best that was possible under the circumstances has been attempted, the work done up-to-date could have been greatly improved upon if adequate staff were afforded.

Enquiries which could be disposed of on the basis of information in published literature, were attended to by the Publicity and Liaison Officer, thus avoiding waste of time of research officers.

33 publications of the Institute and Colleges were sent to the Press : and for such of them as required publicity, press summaries were prepared and furnished to the Deputy Principal, Information Officer, Ministry of Agriculture, Government of India. Printing facilities remained extremely unsatisfactory and even the smallest publications were badly delayed in the presses.

To expedite matters, a short silvicultural note on *Broussonetia papyrifera* and the bulky reports of Branches for the meeting of the Central Advisory Board on Forest Utilisation, were prepared by cyclostyling the matter and providing printed covers only, the use of this procedure may be extended as a routine practice with reference to all our leaflets.

The Institute took part in the All-India Exhibition in February—March 1918, in Calcutta.

Arrangements were made for a Plywood Conference in July, 1917, and for the first post-war meeting of the Central Advisory Board on Forest Utilisation in March, 1918.

Arrangements were made for trainees in the various Branches—these included army officers, forest officers, nominees of Industries etc.

A course of 6 lectures on Forestry was delivered to the Indian Administrative Service Classes.

Visitors were, as far as possible, shown round the Institute and Colleges and to work of the Institution explained to them fully.

CHAPTER II.

SILVICULTURE BRANCH

1. EXPERIMENTAL SECTION

(A) NATURAL REGENERATION

(*i*) *Seed Production* :—

Total seed crop (Experiment No. 10) from individual trees of *Tectona grandis* Linn. and *Terminalia tomentosa*, Kurz. was collected and weighed. It was a good seed year for *Terminalia tomentosa*, average yield per tree being 4 lbs. 12 oz. but a poor one for teak, average yield per tree being only 2 lbs. 6 oz.

(*ii*) *Investigations on seed.*

(*a*) Seed weighment and germination per cent. (Experiment No. 11).

Seeds of 65 species were examined which included six species tested for the first time, three species carried forward from the previous year, and three species of other special interest. The details of the twelve species of special interest are given below :—

Species	Month of seed collection Receipt	Source of collection	No. of seeds per			Germination %	Remarks
			lb.	oz.	qr.		
Piptadenia buchananii	X	Nayasaland	..	450	..	*Nil.*	
	Feb. 47						
Khaya nyssica ..	,,	,,	..	76	..	*Nil.*	
Oxytenanthera abyssinica.	Sept. 46	,,	..	328	..	75	
	Feb. 47						
Mammea americana	X	Trinidad	10	*	..	*	*No germination so far.
	Jan. 48						
Araucaria cunninghamii	X	Brisbane	1928	..	..	5·5	
	June 47						
Araucaria cunninghamii	X	F.R.I.	..	..	..	*Nil.*	1931 plantation seeded for the 1st time. No seed was found sound.
	June 47						
Cornus florida ..	Sept. 47	F.R.I.	..	640	..	*Nil.*	1941 plantation seeded for the 1st time. Under observation yet.

Species	Month of seed collection Receipt	Source of collection	No. of seeds per lb.	oz.	qr.	Germination%	Remarks.
Markhamia platycalyx	X	T.R.I.	..	1110	..	50	2 years. old plant seeded germination continuing.
	Dec. 47						
Sporobolus wightii ..	X	Kew, London.	..	..	..	25*	*seedlings per grain.
	Nov. 46.						
Panicum obtusum ..	X	"	..	..	..	6	
	Nov. 47						
Vitex pedunculoris	X	Assam	..	600	..	*	*please see under storage.
	Dec. 47.						
Nepenthes khasiana ..	X	Assam	..	730	..	..	
	Dec. 47						
Agathis robusta ..	X	Brisbane	..	618	..	..	
	June 47						

(*b*) The special tests on *Juniperus macropoda* berries were continued. Results are reproduced under precowing treatment.

Seed storage (Experiment No. 12).

The results obtained are produced below :—

Species	Date of storage	Method of storage: Sealed tins	Paper envelope	Gunny bag	Period of storage in years.
Albizzia procera	1027 May	6·0	..	..	20
Acacia arabica	1931 July	4·7	..	..	16
Acacia arabica ..	1936	6·0	..	4·3	11
Kydia calycina	1939 Feb.	6·3	..	..	9
Leucaena glauca	1938 Sept.	2·3	..	1·0	
Artocarpus fraxinifolius ..	1939 Aug.	14·0	..	*Nil.*	
Cryptolegia grandiflora ..	1943 July	0·2	..	*Nil.*	
Dendrocalamus strictus ..	1943 Aug.	*Nil.*	..	*Nil.*	
Prosopis juliflora (pods) ..	1944 Sept.	12·0	..	..	
Prosopis glandulosa (pods)	1944 Sept.	*Nil.*	..	..	

Species	Date of storage	Method of storage		Gunny bag	Period of storage in years
		Sealed tins	Paper envelope		
Pueraria thunbergiana ..	1946 March	33·4	24·0	..	1
Ochroma lagopus ..	1947 May	..	..	..	*Nil.*
Agathus palmerstonii .	1947 June	16·6	..	..	*Nil.*
Agathus robusta ..	1947 June	2·4	..	..	*Nil.*
Oxytenanthera abyssinica ..	1947 June	75·0	..	..	*Nil.*

(*c*) Some seeds are badly attacked in storage by insects, necessitating use of insecticides. The effect of the latter on germination capacity of *Prosopis glandulosa* clean seeds was tested. The result is produced below which indicates that the seeds could be stored safely without much loss in germination capacity. The germination per cent. of unstored untreated seeds of this species is 60 per cent.

Treatment	Period of storage (in sealed tins)	Germination per cent.	No. of tests of 100 seeds each
Paradichlor benzene in excess	1-11-44 to 6-3-47	39%	5
Napthaline in excess	Do.	48%	5
Untreated control	Do.	40%	5

(*d*) Seed presowing treatment :—

Germination per cent. of different species tried under different treatments is given below :—

Species	Treatment		
	Immersion in cold water for 24 hours	Immersion in boiling water and allowing it to cool for 24 hours.	Control.
Vitex peduncularis	25%	17%	7%
Prosopis juliflora (Peruvian form)	62%	71%	14%
Prosopis juliflora (Australian form)	70%	73%	41%

Fruits of teak were treated with commercial sulphuric acid for 1 hour, 45 min., 30 min, and 15 min., with one soaked control. Germination per cents obtained were 34, 16, 16, 6 and 8 respectively.

Germination of *Juniperus macropoda* seeds both in natural forests and in nurseries is very poor. Presowing treatments tried have not given any satisfactory results thereby indicating action to shorten the after-ripening period. Seeds collected from 1-year, 2-year, and 3-year old berries were put in pits, 2 ft. below ground. Results obtained are produced below :—

Date of collection	Date of putting in the pit	Date of taking out and sowing	Germination %		
			1 year. old	2 year. old	3 year. old
1-12-1947	3-1-48	3-2-48	1·1	2·7	2·7
	control.	3-3-48	10	20	A-4
		3-1-48	*nil.*	*nil.*	*nil.*

The total germination shown above was obtained within 14 days of sowing after which the seeds become dormant again. The test is being continued.

(*iii*) *Investigation on trees and crops.*

(*a*) Phenology (Experiment No. 1). Observation continued on the phytophases of the following species :—

1. *Acacia arabica.*
2. *Aleurites fordii.*
3. *Aleurites montana.*
4. *Broussonetia papyrifera.*
5. *Caltis tetrandra.*
6. *Pinus longifolia* (5 origins).
7. *Tectona grandis.*

A scheme has been prepared under which 24 species of common occurrence in the forests will be kept under phenological observation, all provinces co-operating. Another scheme has been prepared under which teak of different origins growing together will be kept under observation throughout their life to investigate if the different races modify their behaviour to suit the local conditions.

(*b*) Seasonal course of height growth (Experiment No. 2).

Ten plants of each of the following species were measured for height growth fortnightly and weekly during the growth period.

*Araucaria cunninghamii** Ait. *Araucaria bidwillii*, *Hovenia dulcis** Thunb., *Melia azedarach* Linn., *Michelia champaca** Linn., *Ougenia dalbergioides* Benth., *Pinus caribaea*, Morelot, *Shorea robusta*, Gart and *Terminalia chebula* Retz.

(*c*) Seedling development (Experiment No. 3).

Hymenodictyon excelsum and *Albizzia lebbek* were taken up to determine the stage at which the future of transplants from nursery may be taken as assured. Nursery plants were transplanted in crow bar holes during rains.

Grade I Seedlings half the height of the tallest seedling on the bed, or over.

Grade II Seedlings less than half the height of the tallest seedling on the bed.

Grade III Badly suppressed, weakly, damaged, and other defective seedlings.

Species	Grade	Survival per cent at the end of—		Average height in inches at the end of—		Remarks.
		1st season	2nd season	1st season	2nd season	
Hymenodictyon excelsum ..	I	77	80*	2·8	10·8	*3 dead later produced coppice.
	II	42	20	2·1	6·9	
	III	25	10	1·5	6·1	
Albizzia lebbek	I	69	18	4·8	15·3	
	II	61	20	4·5	16·8	
	III	50	18	3·6	15·8	

(*d*) Inheritance of climatic and physiological characters (Experiment No. 6). The plantations of *Acacia catechu, Schleichera trijuga* and *Butea frondosa* of different origins were maintained.

(*e*) Inheritance of individual characters :—

The results of the present investigation will be published when ready. Two new projects were drawn up, one to study effects of burning and grazing on the production of twist, the other to study the inheritance of twist in plants raised from self pollinated seeds of twisted mother trees. The female flowers of three twisted trees in the Gurkha lines were bagged. Unfortunately the unit staying there was transferred and the new occupants destroyed the bags not knowing what they were meant for.

The coppice plot of *Terminalia crenulata* to study the inheritance of figured wood character and the *Pinus longifolia* plantation to determine the inheritance of resin yield capacity were maintained.

(*f*) Changes in soil and ground vegetation on afforestation (Experiment No. 48 and 49).

Ecological quadrats under different forest crops were maintained and the frequency of occurrence of the ground flora was recorded. Soil samples were taken by the soil chemist and analysed.

*These species are included in the investigation of seasonal course of diameter growth by the Wood Technologist.

(*g*) Effect of early pruning on height growth of *Pinus longifolia* (Experiment No. 99).

The experiment was maintained and diameter and height measurements were taken on the 9th January, 1948.

Treatment	Av. diameter (inches)		Total height (inches)	
	Previous year	Present year	Previous year	Present year
A (Pruned to $\frac{1}{4}$ height)	5·4	5·6	409	441
B (pruned to $\frac{3}{4}$ height)	5·1	5·3	404	434
Control	5·9	6·1	413	448

(B) ARTIFICIAL REGENERATION

The 1947 monsoon broke out at Dehra Dun on 27th June and continued till 3rd October 1947. There was 1 pre-monsoon shower in April, 2 showers in May and 3 in June up to the 16th. After the setting in of the monsoon, there was 1 break in June, 5 breaks in July, 8 in August and 4 in September. The breaks were of 4 days in July, 3 days in August and 2 days in September; otherwise they were only of one day. The total rainfall of the calendar year was 89·77 inches. From the beginning of second week of October 1947, till the end of January, 1948, there was practically no rain, and this was followed by 5 showers in February and 7 in March 1948. The frost was very mild and the minimum temperature recorded was 37·0° F. on 7th and 19th January, 1947.

Delayed date of planting stump: (Expt. No. 25). The experiment was conducted to determine the extent of loss due to undue delay in stump planting. *Dalbergia sissoo* was raised in the nursery. 25 stumps were made each day on 10th July, 25th July, 10th August, 25th August and 10th September, and were planted in crow bar holes. The stumps were properly randomised and routine weeding was done. All the stumps were measured on 12-12-1947 for total height. The mean total height in inches was 15·3, 11·0, 10·2, 7·7 and 5·3, for the respective dates. The difference between all pairs, except between the 2nd and 3rd planting date, is significant.

Effect of the diameter of stump. (Expt. 26).

To determine the optimum diameter of stumps for planting out, 40 stumps of *Bischofia javanica* were prepared for each of the five size classes and planted in crow bar holes. The measurements are given below. It was found that sizes A, B and C were superior to D and E, but there was no significant difference between themselves.

Treatment	Stump. Size	Survival per cent.	Mean height
A	0·7"—0·6"	100	9·2 inches
B	0·6"—0·5"	100	8·6 ,,
C	0·5"—0·4"	100	8·3 ,,
D	0·4"—0·3"	100	7·0 ,,
E	Less than 0·3"	95	4·1 ,,

Effect of splitting stumps longitudinally (Expt. 26 A).

Stumps of *Tectona grandis* were prepared, and divided into 3 lots. Each stump of the first lot (A) was planted intact, each of the second lot (B) was split into two and planted and each of the third lot (C) was split into four and planted. There were 48 planting strips under each treatment obtained from 48, 24 and 12 stumps respectively. The survival per cent and the mean height at the end of the first year were 92 (11·3"). 69 (8·0") and 18 (7·0") respectively. It is now felt that instead of equal number of planting strips equal number of stumps should be taken for each treatment.

Storage of stumps before planting (Expt. No. 31). Two types of storage, (*i*) stumps being kept covered with a gunny moistened from time to time and (*ii*) stumps being kept in the laboratory under shade without any cover, were tried with stumps of *Dalbergia sissoo* for the fourth time and with stumps of *Bischofia javanica* for the first time. The stumps were prepared on the following dates and stored till the time of planting.

(*i*) *Moist stumps.*	(*ii*) *Dry stumps.*
A. 5th July 47 (control, no storage)	E. 2nd July 47 (3 days storage)
B. 20th June 47 (15 days storage)	F. 30th June 47 (5 days storage)
C. 10th June 47 (25 days storage)	G. 27th June 47 (10 days storage).
D. 21st May 47 (15 days storage)	H. 20th June 47 (15 days storage).

These eight sets of 10 stumps each were planted in crow bar holes on 5-7-1947, weather and soil being quite suitable for planting. Results at the end of 1947, were as follows:—

Treatments	*Bischofia javanica*		*Dalbergia sissoo*	
	Survival %	Average height inches	Survival %	Average height inches
A	100	10·5	100	10·6
B	95	11·3	93	18·2
C	93	10·5	98	18·9
D	93	9·6	95	14 3
E	95	10·3	98	16·1
F	80	9·5	95	15·5
G	3	3.0	5	11·0
H	*Nil*	*Nil.*	*Nil.*	*Nil.*

Comparison of nursery and forest stumps (Expt. No. 46).

50 stumps of *Morus alba* each from nursery grown and from forest plants of as comparable age and size as possible, were planted out in crow bar holes 2ft. apart, in lines.

Results obtained at the end of the first growing season are as given below :

Seedling origin of stumps	Survival percent.	Average height of shoots in inches
Nursery	100	19·9
Forest	91	15·9

Comparison of sowing, transplanting and stumping (Expt. No. 53).

Two species, *Terminalia tomentosa* and *Markhamia platycalyx* were tried and at the end of the year, the following results were obtained :—

Species	Sowings		Transplanting		Stumping		Remarks.
	Survival %	Av. ht. in inches.	Survival %-	Av. ht. in inches	Survival %	Av. ht. in inches.	
Terminalia tomentosa.	93	9·8	27	9·1	64	8·1	Difference in hight not significant.
Markhamia platycalyx.	7	7·4	73	9·7	84	8·4	

Comparison of nursery and forest transplants (Expt. No. 56).

Cedrela toona was tried for the fourth time. 50 plants were taken from nursery and another 50 from natural seedlings in the forest of comparable age, vigour and size. These were transplanted and measured at the end of the growing season :—

Stock	Survival percent	Mean height
Nursery plants	20	3·5 inches
Forest plants	42	1·7 inches

Stump planting in the open in winter (Expt. No. 23).

100 stumps each of *Cinnamomum camphora* and *Bischofia javanica* were planted in the open on 7th January. By the end of March, 54 of the former and 71 of the latter had sprouted, but during June all of them died. It seems stumping in winter is possible but the root system does not grow well enough in this short period to withstand the drought of summer.

Method and duration of storing seedlings (Expt. No. 108).

Pterospermum acerifolium was taken up. The following methods of storing and duration were tested :—

Storing	Duration
(A) Each seedling in a ball of earth.	(1) 80 hours till transplanted.
(B) Several seedling in a ball of earth.	(2) 66 hours till transplanted.
(C) Seedlings submerged in a cold water bucket	(3) 42 hours till transplanted
(D) A wet gunny wrapped round the roots	(4) 18 hours till transplanted.
	(5) 6 hours till transplanted

At the end of the year, the following results were obtained :—

Treatment

Particulars	Method of storing				Duration of storage				
	A	B	C	D	1	2	3	4	5
Height increment in inches	1·0	1·4	1·3	1·1	1·3	1·3	1·1	1·2	1·3
Survival %	81	86	97	94	89	95	86	88	90

Size of seeds on seedling production (Expt. No. 57).

Large seeded and small seeded *Eugenia jambolana* were taken up for trial. The results are produced below :—

	Seed diameter	Germination %	Average height
Large seeded	1·0" to 0·9"	84·0	4·6"
	0·9" to 0·8"	88·2	4·5"
	0·8" to 0·7"	91·0	4·6"
Small seeded	0·7" to 0·6"	71·5	4·7"
	0·6" to 0·5"	73·0	5·2"
	0·5" to 0·4"	71·5	4·9"

Best date of sowing (Experiment No. 107). *Anogeissus pendula* and *Terminalia tomentosa* (*alata*) were tried by repeating sowings fortnightly in the open from 25th April 1917, continuing till 25th June 1917. The results

obtained at the end of the growing season were as follows :—

Average height in inches.

Date of sowing	*Terminalia tomentosa (alata)*	*Anogeissus pendula*
25-4-47	12·0	5·4
10-5-47	11·7	4·5
25-5-47	12·7	0·0
10-6-47	10·1	5·9
25-6-47	10·7	4·3

Season for planting stumps during cold and hot weather (Expt. No. 42 and 61)

50 stumps of *Anogeissus pendula* were planted out in crow bar holes at random at fortnightly intervals from 15th November 1946 and continued till 15th June 1947. At the end of the season plants were counted and height measurements recorded as given below :—

Dates of planting	Average height in inches	Survival %
15th Nov. 1946	11·2	52
30th Nov. 1946	9·7	68
15th Dec 1946	10·4	72
30th Dec. 1946	8·2	38
15th Jan. 1947	4·0	28
31st Jan. 1947	8·4	16
15th Feb. 1947	11·0	2
1st March 1947	4·0	4
16th March 1947	*Nil.*	*Nil.*
31st March 1947	8·9	72
16th Apr. 1947	8·5	58
1st May 1947	7·7	52
16th May 1947	9·5	70
31st May 1947	8·8	32
15th June 1947	9·7	72

(C) MISCELLANEOUS

The small plantations (Experiment No. 94) of *Agathis palmerstonii* (1937), *Celtis tetrandra* (1937), *Cinnamomum camphora* (1944), *Cornus florida* (1941), *Cupressus torulosa* (1937), *Diospyros tomentosa* (1941), *Eugenia jambolana* (1942), *Hovenia dulcis* (1936), *Pinus caribea* (1937), and *Quercus suber* (1942, 1944) were maintained. *Cornus florida* produced seed for the first time, which have been tested.

Araucaria plantations (Experimet No. 68). The *Araucaria cunninghamii* plantation of 1931 and *Araucaria bidwillii* of 1929 and 1936 were maintained. The former produced seed for the first time, which have been tested.

The plantations of *Aleurites montana* and *Aleurites fordii* were maintained. The yield of the fruits was $9 \cdot 29 \pm 1 \cdot 88$ seers and $7 \cdot 4 \pm 0 \cdot 59$ seers respectively. It has been observed that while all the fruits of *Aleurites fordii* ripen and fall at one time those of *Aleurites montana* fall in batches. This year the fruits of *Aleurites montana* were collected accordingly and hence the marked increase in yield compared to previous years. It should be borne in mind that these plants are grown in closed plantations under forest conditions, and no irrigation, soil working, manuring or any other cultural treatments is being applied.

Experimental plot files on 8 sets of experiments were received from the provinces and statistically analysed. These included a set of files on all-India co-operative bamboo experiment and another set of files on the effect of burning on *Shorea robusta* plantations.

During the latter part of the year, the computing staff of the experimental section were transferred to man the newly established statistical branch. This has created difficulties in the working and to a certain extent lowered efficiency. The statistical work has to be taken either to the Statistical Assistant Silviculturist or to the Statisticians, and in neither case the Experimental Assistant Silviculturist can guide the computation and analysis as it progresses. It is proposed to appoint an Assistant Computor to deal with the routine work of this section in future.

(D) F. R. I. ESTATE WORKING PLAN.

Reforestation—

The part of the old fruitecetum of the Botanist in the Golf course block comprising 7·42 acres was cleaned of all weeds and herbaceous growth and all trees other than those required by the Botanist, Forest Research Institute, were felled and sold as fuel. The debris was burnt and 1·5 acre sown were with *chir* seed received from Tehri Garhwal in lines 6′ apart. Due to the shortages of seed the rest of the area was given out for *taungya* cultivation. The area of 7·04 acres reported last year to be deficient and very patchy in germination was again sown with *chir* seed, and now the stock is fairly good.

Two separate small plantations of *Sterculia alata* from local and Assam seeds were raised in the Riding School Block. Both look promising. Another small plantation of *Bauhinia* species brought by Shri A. P. F. Hamilton, Inspector General of Forests, from the Andamans was raised from seedlings 9″ to 1′ high but the plants did not survive the winter.

Thinning—

Chir W. C. compartment Nos. 11, 12, 39, 42, 43, 44, 56 and 58, Champion block were thinned during the year.

Sal *W. C.* compartment Nos. 14 and 15 in canal block were clear felled and the lines of sal stools were cleaned of all debris by the end of second week of March 1948, and the material (left after meeting government requirements such as fence posts etc.), was sold as fuel. Coppice shoots in last year's area of sal in compartment Nos. 18, 19 and 20 were reduced to one or two best shoots per stool.

Teak *W. C.* Teak coppice shoots in compartment No. 37 Teak block were clear felled and the area planted up with *Dendrocalamus membranaccus* 2 years old in seedlings the western half and *Oxytenanthera abyssinica* 4 months old seedlings in the eastern half.

The number of forest offences detected during the year was 187. The compensation realised was Rs. 323/6 (Rs. 1/11 per case and Rs. 1/7/6 per offender.) In 13 cases of illicit grazing and cutting trees the offenders remained undetected.

The value of the produce etc., obtained from thinnings, cleanings and clear felling from the various working circles and disposed of during the year 1947-48 is given below in detail :—

Timber—

	Rs.	a.
(1) 300 fence posts of *chir* and sal prepared for the use of the branch from Champion and Canal blocks	150	0
(2) 360 *chir* fence posts and 30 sal ballies to the Forest Botanist	210	0
(3) 2 mango logs to Wood Workshops 6'—8' girth and 10' long	30	0

Fuel—

302 cart loads of fuel sold to F.R.I. resident @ Rs. 3 per car load	1,05.	0
27 cart loads of fuel sold to the same @ Rs. 4/8 per cart load. (The enhanced rates were brought into effect from 15th February, 1948)	121	8
Revenue from standing dry trees, etc., sold to F.R.I. residents	317	5

Pulp charcoal and fuel—

10 lorry loads of *Broussonetia papyrifera* logs from 3" to 10" diameter supplied to Paper Pulp Branch	120	0
800 culms of bamboo supplied to Paper Pulp Branch	800	0
2 lorry loads of *Kydia calycina* for Paper Pulp	24	0
4 lorry loads of *chir* fuel for boilers	51	0
2 lorry loads of *chir* fuel to C. and M.F.P.	18	0
6 freshly cut *chir* logs to C.W. and W. P...	6	0
12 *Dendrocalamus strictus* culms to W. and W. P.	12	0
225 billets of sal supplied to C.W	20	0

	Rs.	A.
Grass and grazing—		
Grazing fees and leases	326	8
Grass leases	340	0
Estimated cost of 500 free grass permits issued to staff allowing them to take one head load per day	3,000	0
Bamboos from D.A. and New Forest for brooms, sports etc.	80	0
Fruit leases	2,700	0
Estimated cost of garden fruits given free to lower staff	900	0
Land rent—		
Cultivation leases to residents	29	8
Cultivation leases to the Military Dairy Farm	200	0
Right of way	35	0
Free grant of gardening lease	28	0
Compensation of forest offences	323	0
Slash removed free of charge by the F.R.I. posts, 200 head loads at /1/ per head load	51	10
Grand Total ..	11,166	10

II. STATISTICAL SECTION

(*i*) *Routine computations—*

286 plot files were received for computation from various provinces which, added to 100 plot files brought forward as arrears from the previous year, made up a total of 386 files requiring computation. Of these, 260 files were computed during the year and 31 files needed no computation; thus 95 files were carried forward as arrears.

(*ii*) *Revision of the statistical code—*

The statistical code was completely revised incorporating the addenda and corrigenda approved by the Silvicultural conferences.

(*iii*) *Enumeration data—*

The partial (10 %) enumeration data of Bhimaram F. S. of south Chanda division were statistically analysed and the results communicated to the Conservator of Forests, W. P. and S. circle, C. P. and Berar.

(*iv*) *Stem analysis data.*

The growth figures and the relevant curves compiled from the stem analysis data as detailed below were sent to the Conservator of Forests, W.P. and S. Circle, C. P. and Berar.

Species	Forest Division	Remarks.
Tectona grandis	Nagpur—Wardha	..
Do.	Hoshangabad	Separately for two qualities.
Gardenia latifolia	Do.	..
Tectona grandis	Nimar	..

(*v*) *Miscellaneous*—

Work was done in connection with the revision of "Manual of Indian Silviculture" Part I.

The Silviculturist from Sind and one forest officer from Assam underwent a course of training in the statistical section.

(*vi*) *Field work*—

23 sample plots in Chakrata division (U. P.) were remeasured by the F. R. I. sample plot party during May-June.

The *chir* thinning research plots in the Demonstration Area, F. R. I., were maintained and remeasured according to prescriptions.

The *Broussonetia papyrifera* plot in the Demonstration Area was also remeasured.

(*vii*) *Staff*—

Due to the partition of India, the posts of one computor and two field assistants remained vacant for about six months and one computor was transferred to the photo section for eight months.

Three computors were permanently transferred to the new statistical branch from 1st August.

III. MISCELLANEOUS

(*i*) *Publications*—

Abstracts of Indian forest literature were prepared regularly for each quarter of the year.

The following publications were issued during the year—

1. Conference Proceedings of the VI and VII Silvicultural Conferences.
2. Leaflet No. 38 (Urdu Edition) "Land Use and Erosion" by Jagdamba Prasad.
3. Bulletin No. 138 "The Recording of Soil and Site Characteristics in the Field, by Dr. A. L. Griffith and R. S. Gupta.
4. Leaflet No. 96 "Efficiency of Enumerations" by Dr. A. L. Griffith.
5. Indian Forest Record Vol. VII No. 1, "Seed Storage with Particular Reference to the Storage of Seed of Indian Forest Plants" by T. V. Dent.
6. Bulletin No. 141 "Teak Soil Laterization" by Dr. A. L. Griffith and R. S. Gupta.
7. Silviculture Research Code Vol. III, "The Tree and Crop Measurement Manual" by Dr. A. L. Griffith and Jagdamba Prasad.

8. Indian Forest Records IVA No. 5, " General Standard and Commercial Volume Table for *Terminalia tomentosa*" W. and A., by Dr. A.L. Griffith, Bakhshi Sant Ram and Jagdamba Prasad.

List of contributions made by the Silviculture Branch to the *Indian Forester*, etc., during the year 1947-48.

Title of the paper	Name of periodical in which published with reference to Vol. No. and page etc.	Name of the Author
1. Soil Erosion Surveys	*Indian Forester*, April 1947 Vol. 73, No. 4, pp. 145-154	A. L. Griffith.
2. Farm Forestry	*I. Forester*, Vol. 73, No. 5, pp. 206—11	Do.
3. A note on *Araucaria cunninghamii*	*I. Forester*, Vol. 73, No. 5, pp. 211-14.	K. L. Lahiri.
4. Further notes on aerial reconnaissance for forest officers.	*I. Forester*, Vol. 73, No. 6, pp. 237-40.	A. L. Griffith.
5. The organisation of post-war silviculture research.	*I. Forester*, Vol. 74, No. 9, pp. 401-2.	Do.
6. The effect of burning on soil as affecting artificial regeneration.	*I. Forester*, Vol. 73, December, 1947	Do.
7. Pruning in plantation	*I. Forester*, Vol. 74, January, 1948	J. Prasad.
8. Thinning appropos snow damage in *C. deodara* and *P. excelsa* crops	*I. Forester*, Vol. 74, February, 1948	Do.
9. Congestion of clamps in *D. strictus*.	*I. Forester*, Vol. 74, February, 1948	K. L. Lahiri.
10. Silviculture of ten species of bamboo suitable for paper manufacture.	*I. Forester*, Vol. 74, March. 1948	J. Prasad.

(*ii*) *Enquiries*—

Routine enquiries and examination of working plans were attended to as usual.

(*iii*) *Documentation*—

All ledgering work was kept up to date but due to shortage of staff a large number of foreign literature had to be done by titles only.

As usual, supplements were written to the list of books added to all institute libraries giving short notes on interesting books for the use of the provincial research officers.

At the Seventh Silvicultural Conference a resolution was passed to revive the supply to provincial and states research officers the list of titles from various periodicals and journals put into the Central Silviculturist's ledger files, and this is therefore being continued.

The abstracting of information of Indian forestry literature was also continued, for supply to various scientific abstracting agencies.

The number of new ledger files opened were 38 specific and 6 general, bringing the totals upto 2,590 and 663 respectively at the end of the year. 165 books, pamphlets and miscellaneous leaflets were added to the branch library. The referencing catalogue was also kept up to date but due to shortage of clerical staff its revision could not be taken up.

The ledger clerk was sent to Bengal Silviculturist's office to collect some literature for the ledger files.

(*iv*) *Photography*—

253 negatives and 1,645 prints were made. Of the new negatives 25 were photos taken on tour by the Central Silviculturist in United Provinces and rest were taken at the Forest Research Institute.

The total number of prints in the general series is now 7,612 and in specific series 7,372 against 7,385 and 7,287 respectively last year. Thus a total of 312 photographs was added to the collection during the year.

No lantern slides and stereo pairs were added to the collection.

485 blocks were reproduced in Forest Research Institute publications, the *Indian Forester* etc., and have been added to the collection.

807 prints were prepared for different provinces and other institutions and about 100 were made for reproduction in various publications.

60 'V' size poor negative were treated during the year.

(*v*) *Museum*—

Due to the sudden death of Sj. Darshan Singh our museum, artist, no new work could be undertaken in the museum except repairs to the existing models. The post has been vacant for the last 7 months and has now been filled up temporarily.

(*vi*) *Tours*—

The Silviculturist toured in the Tehri Garhwal state in May-June 1947, and visited Allahabad and Delhi in connection with the revision of the Manual of Law. The Statistical Assistant Silviculturist with a sample plot party toured in Chakrata division to measure sample plots. The Experimental Assistant Silviculturist toured in E. Bengal and in the Lansdowne division U. P. and along with the S.A.S. in Chakrata to learn sample plot work

(*vii*) *Staff*—

The Silviculturist, Dr. A. L. Griffith, proceeded on leave preparatory to retirement handing over charge to Shri Jagdamba Prasad on the 31st December, 1947. The Assistant Silviculturist Shri D. R. N. Murthi Row, remained seconded to the College for lecturing in Forest Engineering. The Soil Chemist Dr. R. S. Gupta. left the branch on his appointment as Agricultural Chemist to the U. P. Government at Kanpur.

We regret to record the deaths of Shri Darshan Singh museum, artist, and B. M. Singh ex-surveyor of the branch.

CHAPTER III

BOTANY BRANCH

Systematic Botany—

1. *Herbarium*—Repair and incorporation of the herbarium specimens proceeded on the usual lines. 1,100 specimens, partly current receipts and partly accumulated arrears were laid in. Among the more important acquisitions of the year were the collections, mostly grasses, of Dr. N. L. Bor, C.I.E., from Sikkim and Tibet, of Sir Basil Gould from Bhutan and Sikkim, of Dr. H. F. Mooney, I.F.S., from the Eastern States and various parts of Orissa, and a consignment of about 225 specimens received on exchange basis from the Director, Botanic Garden, Singapore.

The material of the family Scrophulariaceae amounting to some 1,280 sheets which had been loaned out before the outbreak of war to Dr. F. W. Pennell, of the Academy of Natural Sciences, Philadelphia, in connection with his monograph of the Scrophulariaceae of the Western Himalayas was received back during the year. A large number of new species described by him are based on our collection. It was rearranged and put back in the herbarium.

In addition to the treatment of incoming and borrowed material, several thousand specimens which showed signs of the presence of beetles were removed from the herbarium and passed through the fumigation chamber. These include the genera *Sorghus*, *Lactuca Crepis*, *Oenothera*, *Peltophorum*, *Ranunculus* and *Astragalus* besides materials of the families *Cruciferae*, *Capparidaceae*, and *Solanaceae*.

2. *Photographs and Drawings*.—60 photographs and 18 drawings were added to the existing collections during the year under review.

3. *Loan, distribution and acquisition*.—A large number of specimens was sent out on loan for purposes of study to various Institutions in India and abroad. The entire collection of the family Cucurbitaceae totalling about 710 sheets was forwarded to Sir William Wright Smith, Regius Keeper, Royal Botanic Garden, Edinburgh, for the use of Mr. Chakravarty in connection with his revision of the Indian *Cucurbitaceae*. 1,075 sheets of the genus *Grewia* were sent to Mr. V. Narayanaswami of the Botanical Survey of India, Calcutta. 47 sheets of *Crotalaria* and 9 of *Papaver* were loaned to Prof. K. N. Kaul of the Agricultural College, Kanpur. A large number of Indian grasses, mostly of the genera *Poa*, and *Ischaemum* was forwarded to the Director, Royal Botanic Gardens, Kew, for the use of Dr. N. L. Bor who is engaged on the revision of the Indian Gramineae.

A total of 744 specimens was donated to the various herbaria. Of these 732 specimens mostly grasses and carex were sent to the Royal Botanic Gardens, Kew, 9 to the Edinburgh herbarium, 5 sheets of *Selaginella* to the British Museum, Natural History. 227 specimens were received in exchange from the Director Botanic Garden, Singapore.

4. *Identification*.—As usual a great deal of identification work was carried out for the various provincial forest and agricultural departments, commercial

firms, educational institutions and many others. Among the more important collections received for identification during the year the following are worthy of note :—

About 150 specimens sent by Dr. H. F. Mooney, C.I.E., I.F.S., from the Eastern States, 420 from the Tibet and Sikkim collected by Dr. N. L. Bor, 48 from Lhasa forwarded by Mrs. R. J. Guthrie of the British Mission and 48 collected from Kashmir by Dr. R. R. Stewart, Principal Gordon College, Rawalpindi.

The following are the larger contributors of the many useful collections received for determination during the year besides those mentioned above : — Sir Basil Gould from Bhutan ; Disease Investigation Officer, Hissar, Superintendent Horticultural Operations. New Delhi ; Conservator of Forests, Working Plans and Utilisation Circle, East Punjab ; Land Management Officer, Etawah ; Silviculturist, U.P., and N.W.F. Provinces ; Curator, Baroda Museum ; Dr. Johri, Dungar College, Bikaner ; Prof. Balwant Singh, Ayurvedic College, Banaras ; Prof. of Botany, Royal Institute of Science, Bombay ; Dr. Srivastava of the Allahabad University ; Dr. Misra, Prof. of Botany, Saugor University and Imperial Economic Botanist, Indian Agricultural Research Institute New Delhi.

Specimens which could not be satisfactorily determined at Dehra Dun, were, as usual, sent either to Kew or Calcutta for identification or confirmation of the names suggested. The help rendered by these Institutions is greatly appreciated and hereby acknowledged.

5. *Nomenclature.*—Several enquiries on nomenclature problems were received and dealt with during the year. In addition to the above, Dr. H.F. Mooney, C.I.E., I.F.S., sent his supplement to Haine's Botany of Bihar and Orissa with the request that the names adopted by him should be checked according to the International Rules of Botanical Nomenclature. This naturally consumed considerable time as it involved both nomenclatural and taxonomical investigations.

6. *Library.*—Eighty one books dealing with various aspects of Botany, besides the usual periodicals were added to the library during the year. In addition to the above a number of reprints and pamphlets presented by various authors was also received.

7. *Seed Supply.*—Demand for seed required by provincial forest officers and overseas correspondents increased considerably. Our seed exchange list was as usual sent to 35 Institutions in India and abroad with whom regular exchange relations exist. 220 packets and about 15 lbs. of seed were supplied to our various correspondents during the year. Plant material for research and demonstration work was also forwarded to a number of correspondents in India and outside. In addition to the above, arrangements were made for the supply of seeds against a large number of indents for which seed could not be collected locally.

8. *Botanical Gardens and Herbarium.*—From several points of view the year was very satisfactory for the welfare and development of plants as adequate rainfall evenly distributed helped considerably to counteract the very dry

season recently experienced. Spring weather was favourable on the whole resulting in the early display of the mixed herbaceous border, sweet peas and other winter flowering shrubs and trees.

Inspite of occasional labour difficulties work in the Botanical Garden and Arboretum progressed satisfactorily. In the garden, nursery stock of ornamental trees, shrubs and climbers had again to be increased owing to the large demands that had to be met. In addition a large number of plants were also raised for planting in the Arboretum and Botanic Garden. 300 plants and cuttings were distributed to various correspondents.

A large portion of the terrace of the main building which was put under temporary cultivation during the war years was brought under movable condition by removal of stones and boulders, levelling and planting with grass.

350 plants representing 7 families and 11 genera were planted out in the Arboretum Little damage was done to plants by frost as the winter was comparatively a mild one.

9. *Miscellaneous.*—A very large number of enquiries covering a wide range of subjects, namely botanical, horticultural, economic distribution, sources of supply and availability of plants and botanical literature was received and dealt with. In connection with the partition of India considerable time of the staff was spent in evaluating assets etc., and in sorting duplicate herbarium specimens for Pakistan.

10. *Publications.*—A paper on 'A Little-known Burmese Bamboo' by Mr. M. B. Raizada was sent for publication in the *Indian Forester.*

Parts XXV, XXVI and XXVII of the serial 'Some Beautiful Indian Climbers and Shrubs' by Dr. N. L. Bor and Mr. M. B. Raizada, were published in the *Journal of the Bombay Natural History Society.* The genera dealt with are *Hibiscus, Passiflora* and *Antigonon.*

Mycology—

11. *Study of Indian wood rotting fungi**—

(*a*) Wood rotting tests on hardwood as well as coniferous fungi detailed below were completed :—

(*i*) 4 months tests on 12 coniferous fungi including two species each of *Poria, Polyporus, Lenzites,* and one species each of *Pleurotus, Merulius, Polystictus, Fomes,* and *Schizophyllum* and one form belonging to Thelephoraceae.

(*ii*) 4 months test on 22 hardwood fungi including 6 species of *Polystictus,* 5 species of *Fomes,* 2 species each of *Trametes, Polyporus Stereum* and undetermined rot fungi on Ascu treated bridge one species each of Collybia, Rosewood and rot fungus of untreated woodon bridge.

(*iii*) 8 months test on one hardwood fungus *Lenzites rependa.*

(*iv*) 12 months test on one hardwood fungus *Lenzites rependa.*

* Some of these fungi have been sent to Kew for identification, and others are waiting for confirmation after a critical anatomical examination.

(b) Wood rotting tests on hardwood as well as coniferous fungi detailed below are in progress —

(i) 4 months tests on 7 coniferous fungi including 3 species of *Poria*, 2 species of *Agaricus*, one species each of *Merulius*. *Polyporus* and *Stereum*.

(ii) 4 months tests on 6 hardwood fungi including one species each of *Thelephora*, *Hymenochaete*, *Polyporus*. *Fomes*, *Polystictus* and *Agaricus*.

(iii) 8 months tests on 4 coniferous fungi including one species each of *Agaricus*, *Merulius*, *Polyporus* and *Poria*.

(iv) 8 months tests on two hardwood fungi including one species each of *Polystictus* and *Polyporus*.

12. *Investigation of fungi attacking coniferous timbers*—

About 110 specimens of fungi attacking coniferous trees and timbers were collected from Chakrata. Cultural studies of the undermentioned fungi have been conducted on neutral Malt Agar Badcock's medium, and Tannic acid medium :—

Agaricus spp. on *Pinus excelsa* and *Q. semecarpifolia ; Polyporus schweinitzii* on *P. morinda ; Polyporus* spp. on *Q. semecarpifolia ; Polystictus* spp. on *Q. incana ; Poria sanguinolenta* on deodar ; *Poria* spp. on *A. pindrow*. deodar and *P. excelsa ; Thelephora* on *P. morinda* and *Q. semecarpifolia.*

13. *Causes and formation of Gauj.*—In connection with investigation of sal diseases, the Mycologist undertook a two weeks tour in Bihar (Palamau, Saranda,—Kolhan and Porahat division). He studied the incidence and predisposing causes of stem, stump, and root diseases of sal and its other hardwood associates. He also went to C. P. (Balaghat and Mandala divisions) on 5 weeks' tour. He investigated the pathological symptoms of frost affected types of sal. He observed that in frost pockets brown heart rot fungus (*Gauj*) was associated with drying of advanced trees in groups and sporadic death of immature stems. He also observed that the trees on the drier slopes were desiccated more by silver grey heart rot fungus (*Trametes incerta*) accompanied by heavy attack of *Hoplocerambyx*. than by drought as frequently reported by forest officers.

14. *Dry rot of hard wood timber.*—Fungi causing dry rot on *Terminalia tomentosa*, *Eucalyptus* spp., *Eugenea* spp., and sal were isolated and the following cultures have been established : -

Fomes two spp., *Polystictus* two spp., *Poria* two spp., and two polyporoid organisms.

15. *Pathological survey.*—Observations on diseases of forest trees were made in field ; collection of field data and the predisposing causes were recorded for further work.

16. *Wilt and die back.*—Work on Wilt and die back of *shisham khair babul* and *Casuarina* was carried out as routine work. Due to innumerable

pressing enquiries from the various forest authorities, it is necessary that regular work should be carried out on the basis of long term research.

17. *Routine work.*—

(*i*) *Teaching.*—Lectures in Mycology and Pathology were delivered to the students of the Indian Forest College

(*ii*) *Maintenance of Cultures.*—About 230 cultures were being maintained and 30 new cultures were added to the stock.

(*iii*) *Examination of seed.*—The seeds of different species were examined for the presence of various fungi before being sent to foreign countries.

(*iv*) *Examination of plywood samples for fungus.*—39 specimens received from the officer in charge, Wood Preservation Section were examined.

(*v*) *Routine enquiries.*—Routine enquiries from various forest officers and branch officers of the Forest Research Institute were dealt with.

(*vi*) *Maintenance of herbarium and museum.*—142 specimens of wood rotting fungi were collected and added.

(*vii*) *Photographic and coloured plates and lantern slides collection.*—80 photographs, 10 coloured plates and 7 lantern slides of fungi were added to the existing collection during the year under report.

(*viii*) Fungus specimens were given to Central Agricultural College, Delhi and Pakistan Forest Institute.

CHAPTER IV

ENTOMOLOGY BRANCH

The charge of the Forest Entomology Branch was held by Mr. J. C. M. Gardner, C.I.E., I.F.S., from 1st April, 1947 to 15th May, 1947 (afternoon) when he proceeded on leave preparatory to retirement. Mr. A. H. Khan, I.F.S., Systematic Entomologist, held charge of the branch from 15th May, 1947 until 12th September, 1947. As Mr. Khan had opted for Pakistan, Dr. K. A. Chowdhury, Officer-in-charge, Wood Technology Branch took over and held current charge of the branch from 13th September, 1947 to 29th February, 1948 in addition to his own duties. From 1st March 1948, Rai Bahadur Dr. N. C. Chatterjee was in charge.

The post of Systematic Entomologist was held by Mr A. H. Khan from 1st April, 1947 to 26th June 1947, when he handed over charge of the post to Dr. R. N. Mathur.

Borers of newly felled timber.—A preliminary investigation on the borers for four ever-green species, *Vateria indica*, *Dipterocarpus indicus*, *Terminalia belerica and Polyalthia coffeoides* was conducted at Kannoth, Wynaad Forest Division, Madras and the results reported in detail in the report of the Entomologist for 1946-47.

The results clearly emphasise the necessity of carrying out similar investigation in different climatic regions of India, because the seasonal incidence of the borers, particularly of the family Bostrichidae varies considerably in different localities. On the above lines experiments have been started in West Kanara Division, Bombay, on the borers of *Terminalia tomentosa*, *Terminalia belerica*, *Eugenia jambolana* and *Adina cordifolia* from December 1947 for a period of 12 months.

Borers of sal ballies.—Experiments on the prevention of borer attack on sal ballies (poles of 2 feet girth) were started in April 1946 at Jhajra, Dehra Dun Forest Division. Ballies were felled quarterly in April, July, October and January and exposed to attack with bark and without bark, in the shade and in the open, to determine the effect of these treatments on insect attack at different seasons of the year. Sal ballies felled in April and debarked immediately or a month after keeping them flat, raised on skids *in the forest shade*, are damaged by bostrichid powder-post beetles. Immunity from the attack of borers is obtained if ballies are debarked 2 months or over after felling. The longer the period the ballies are kept with bark on, the more serious is the damage caused by *Xylotrechus smei* a Cerambycid sapwood borer, *Hoplocerambyx spinicornis*, the heartwood borer and also by Curculionidae. On the other hand ballies felled in April, kept flat, raised on skids, out *in the open* and debarked after three months, remained practically immune from bostrichid powder-post beetle attack and no serious damage was done by any other borer. If debarked immediately after felling or one to two months after felling they are attacked by powder-post beetles. If kept in the open with bark intact for over three months, they are liable to serious damage by Cerambycidae, Curculionidae and other borers.

Ballies felled in the rains during July and kept in the *forest shade* both with and without bark were found to be badly attacked by Cerambycidae, Curculionidae Anthribidae Scolytid pin-hole borer. While those kept *in the open* and debarked three months after felling remained immune to bostrichid attack. Ballies debarked immediately or one to two months after felling were damaged by powder post beetles. If debarking is postponed later than three months, the ballies are seriously infested with *Xylotrechus smei* and other Cerambycid borers and also by pin hole borers.

Ballies felled after the rains during October, debarked immediately, and kept in the forest shade remained immune to bostrichid powder-post beetle attack. Ballies debarked one to five months after felling are attacked by bostrichids and if debarking is further delayed the ballies are made useless by additional infestation of Cerambycidae borers. Ballies felled after the rains during October kept *in the open* and debarked two months after felling remained free from Bostrichid attack. Light attack of pin-hole borers develop if debarked immediately or one to four months after felling.

Ballies felled in winter during December and kept in the *forest shade*, if debarked at once or after a period of one to five months after felling are heavily attacked by Bostrichid powder-post beetles. If debarking is delayed to six months or over after felling the ballies are made useless by *Xylotrechus smei*, *Acolestis holasericea* and other longicorn borers Ballies felled in winter during December, kept *in the open* and debarked 5 months after felling remained free from powder-post beetle attack. Ballies debarked immediately or one to four months after felling were heavily attacked by *powder-post* beetles. This and work on similar lines conducted in Sambalpur Forest Division, Orissa are being examined by the Statistician.

Borers of Boswellia serrata, (salai)

The lay out of the experiments has been given in the last report. The results obtained are that planks obtained from logs of monsoon (August) fellings both controls and under treatment remained free from powder-post beetle attack. Heavy attack by powder-post beetles, particularly by *Sinoxylon anale*, took place in planks, (both control and under treatment), obtained from logs of spring (February), summer (May) and winter (November) fellings. The possible explanation is that natural depletion of starch and sugars takes place much quicker in the monsoon than in other months of the year. The quickest period of depletion is 30 days from the time of felling during the monsoon. No appreciable natural depletion of starch and sugars took place in logs and planks obtained in the spring, summer and winter fellings.

Use of D.D.T. against wood borers

Results of preliminary experiments were reported last year and observations were continued during the year also. In April 1947, 11 planks 1 inch thick of *Albizzia procera* were sprayed soon after conversion with 2 per cent D.D.T.—benzene emulsion and 11 planks were kept as controls. The treated planks have remained free from insect attack so far while the controls have been heavily attacked by powder-post beetles. *Albizzia procera* billets swabbed with 2 per cent D.D.T.—mustard oil emulsion and 2 per cent D.D.T.—benzene emulsion in 1946

have remained free from borer attack for the last two years, with only one application of these chemicals. The controls were heavily attacked. Six billets of *Albizzia procera* treated with a D.D.T. proprietary preparation, Rentokil Timber Fluid B in 1946 have also remained free from borer attack for two years. In another experiment started in April 1947, ten billets of *Albizzia procera* were dipped in a 2 per cent D.D.T.—mustard oil emulsion. The treated billets remained free from insect attack while the controls were heavily attacked by powder-post beetles. Experiments with D.D.T. on newly felled timbers against attack by powder-post beetles are in progress in West Kanara division, Bombay and with D.D.T. and Gammexane on plywood at Dandeli Plywood Factory, N. D. Kanara, Bombay.

Resistance of various timber species (untreated and treated) to Termite attack

Untreated timber.—Experiments were conducted in September 1946 in Dehra Dun. The following species were selected :

Deodar (*Cedrus deodara*), mango (*Mangifera indica*), *toon* (*Cedrela toona*), *shisham* (*Dalbergia sissoo*), *sain* (*Terminalia tomentosa*) and *sundri* (*Heritiera minor*). Two pieces each, 8 inches long, ½ inch thick and 2 inches wide of each species, were kept in series on ground in the grave-yard, half the length above ground and half under-ground. Deodar has remained free from attack while the others have been very slightly attacked. The observations are being continued.

Treated timber.—Six inch billets of *Albizzia procera*, treated with Rentokil Timber Fluid B, a proprietary D.D.T. preparation, were subjected to grave-yard tests with controls. Slight grazing by termites was noticed in the treated pieces while the controls have been attacked by termites.

In preliminary experiments conducted with material treated with a coating of wax, it was discovered that gunny sacking and bamboo if coated with wax and subjected to grave-yard tests would ward off termite and ghoon borer attack.

Borers of felled bamboo

Dehra Dun.—Investigations on starch depletion on felled culms were continued in Dehra Dun with a view to determine the effect of age of culms, size of culms and climatical factors on depletion of starch. The experiments were started in 1945 and planned to run for a period of three years. New culms of 1944 rains were marked and labelled, in order that the age of the culm is known at the time of felling. Each month three culms are felled and the initial starch content at the time of felling is recorded. Observations are made on the felled culms weekly and any depletion of starch and attack by the bamboo-ghoon is also recorded. The culms are kept exposed to bamboo-ghoon (*Dinoderus* spp.) attack. The factor of rain seems to play a great part in the depletion of starch in freshly felled culms. The data will be analysed statistically also.

Bombay.—Experiments in clump curing of bamboo (*Bambusa arundinacea*) are in progress in Ramanguli Range, West Kanara Forest division since December 1947.

Teak Defoliators

The plan of work has been described in the last year's report. When the proposed additional staff required for this work is available, a field party would be posted at a suitable place in South India. Reports sent by the local forest officers indicate that very light attack of the teak defoliators, *Hapalia machaeralis* and *Hyblaea puera* occurred between September to November in Coorg and between October to January in Wynaad. The defoliation was reported to be heavy in the Chedleth Range, Wynaad during February. In the Nilambur teak plantation light and sporadic defoliation was noticed from May to November.

Insect pests of Quercus incana

Owing to disturbed condition prevailing in the Punjab, no work was undertaken with the oak leaf rollers, *Apoderus* spp., and the oak borer, *Aphrodisium hardwickianum*

Insect pests of Casuarina equisetifolia

At the request of the Bombay Forest department, investigation on the insect pests of *Casuarina equisetifolia* has been taken up and organised. The investigation would be carried out by the entomologist's field party, working in W. Kanara, Bombay for a period of one year. The insect responsible for causing damage to *Casuarina equisetifolia* in the nursery, is *Gymnogryllus humeralis*, which clips the tips of young plants, causing heavy casualties in the younger stages of growth. Experimental plots have been laid out at Chitakulla, Harvada and Honovar in W.D. Kanara Forest division for field observations and control work. Biology of the pest is under investigation both in the field and at the Dehra Dun Insectary.

Spike disease of sandal.

Assistance was given to the Madras Forest department, engaged in the entomological investigations of the spike disease of sandal by identifying the insects caught on sticky papers and also found dead inside the experimental cages.

Pests of Terminalia paniculata fruits

Local forest officers from Kannoth and Palghat, Madras sent several samples of flowers and fruits to investigate the species responsible for the non-formation of fruits in these localities. Samples examined, so far, show very little evidence of insect damage.

Systematic Entomology

The Systematic Entomologist was completely occupied with the identification and disposals of large number of insects associated with the entomological investigations by this branch. The main reference collection was augmented by the addition of 56 new species. Additions have been made to the identified collection of lepidopterous larvae also. In addition, identification work was done for the Government Entomologist, U.P., Research Officer, R.S.C.R. Station, Pallom, Travancore ; Technical Development Establishment Laboratories, Kanpur ; Lecturer in Zoology, Madras Christian College Tambaram, Madras; Conservator of Forests, Colombo, Ceylon and East Asiatic Company, Rangoon. Contact with foreign specialists is being revived gradually

and material pending identification is being received back. Sorting of specimens for the Dominion of Pakistan was carried out also.

Education

Instructions in Forest Entomology to the students of Indian Forest College and Indian Forest Ranger College were given uptil September by Dr. R. N. Mathur and from September to March by Dr. P.N. Chatterjee. Short courses on the protection of wood and bamboos were given to several parties of personnel from the Army and Military Engineering Service and also to forest officers.

General

During the year 268 consignment of insects and wood specimens were received and 130 enquiries were answered. In the Insectary 179 cages for defoliators, 39 cages for timber borers and 22 cages for seed borers were under operation during the year and a total of 3466 insects were reared.

Tours

Mr. A. H. Khan, Systematic Entomologist, undertook a tour of the Bombay Presidency, from 21st April, 1947 to 15th May, 1947. Dr. R. N. Mathur, Offg. Systematic Entomologist attended a meeting of the Indian Council of Agricultural Research, New Delhi, in connection with the Termite Scheme, in December 1947. Mr. B. M. Bhatia visited the Wynaad Forest Division, Madras, from 5th May, 1947 to 5th June, 1947. Mr. Bhatia and party paid visits to Jhajra, Maihan Range, Dehra Dun Forest Division during April, June, July, August and November. Th. Balwant Singh undertook a tour of the Dharamsala Range, Punjab, from 4th June, 1947 to 26th June, 1947. A field party consisting of Messrs. A. M. Posford, Mohan Lal and Chandra Bahadur has been sent out on tour on 15th December 1947 to Karwar, West Kanara Division, Bombay Presidency for a period of one year. Mr. Bhatia was on tour from 31st December, 1947 to 29th January, 1948 to Sambalpur Division, Orissa and some parts of Eastern States Agency. Dr. N. C. Chatterjee, Forest Entomologist, paid a visit to Calcutta to attend the meeting of the Governing Body and Advisory Board of the Indian Lac Cess Committee, held on 30th and 31st March 1948.

Publications

Gardner, J.C.M.	1947.	Larvae of the Noctuidae III. *Trans. R. Ent. Soc. London.* 98 : 59-90.
————	1947.	A note on the larvae of *Trox procerus* Har. (Scarabaeidae, Col.) *Indian J. Ent.* 8 (1) : 31-32.
————	1947.	Larvae of Cantharioidea (Coleoptera). *Indian J.Ent* 8 (1) : 121-129.
————	1948.	A list of described immature stages of Indian Coleoptera. *Indian For. Rec.* 7 (5) : 163-190.
Mathur, R.N.	1947.	Notes on the Biology of some Mantidae. *Indian J.Ent* 8 (1) : 89-106.
Khan, A.H.	1947.	Insect borers of newly felled timber and their control Part I. *Indian For. Bull.* 136.

In Press

Bhatia B. M.	Plant defoliator parasite complex in the biological control of Teak Defoliators.
Gardner, J.C.M.	Larvae of Noctuidae IV.
Mathur, R. N	On the Immature stages of some Psyllidae—*Indian J Ent*

Library.

During the year 189 books besides periodicals were added to the library.

Much time of the Branch was taken up during the year in evaluating the assets etc., at the time of partition and also in sorting out entomological specimens for Pakistan.

Three of the subordinate staff and one peon opted for Pakistan and these posts have not yet been filled up.

CHAPTER V

WOOD TECHNOLOGY BRANCH

Staff

Dr. K. A. Chowdhury was in-charge of the Branch throughout the year. He was also in charge of President's Office for about 2 weeks in June 1947, when Mr. Stewart, President, was on casual leave. In addition to his own duties he held charge of Publicity and Liaison Branch from May 31st to July 3, 1947, during the absence on leave of Rao Sahib B. S. Chengapa. Again, Dr. K. A. Chowdhury was put in charge of the current duties of Forest Entomology Branch from 6th Sept. 1947 to 1st March 1948.

Mr. K. Ramesh Rao was appointed Assistant Wood Technology Officer with effect from 9th December 1947 and Mr. S. K. Purkayastha was appointed Research Scholar from December 23, 1947.

Two Laboratory Assistants and one Lab. Attendant opted for Pakistan and left the Branch. The post held by these men remained vacant during the rest of the year.

Research

(*a*) Work on the preparation of keys accompanied by photomicrographs for the important commercial timbers of Assam and Bengal remained held up for want of staff.

(*b*) Research on growth activity and variation of starch content in girdled trees was started in Bihar in co-operation with Wood Seasoning Branch. The species selected were *Terminalia tomentosa*, *Anogeissus latifolia* and *Pterocarpus marsupium*.

The study on the effect of girdling on growth activites of *Anogeissus latifolia*, *Eugenia jambolana* and *Terminalia tomentosa* from the United Provinces was continued. Data collected from micro-blocks were analysed.

(*c*) Study of " Red Cutch " (*Acacia chundra*) as a substitute for Lignum-vitae for the manufacture of tail-shaft bearings in ships was further continued. Many sections were cut from materials collected from different parts of India. Considerable difficulties were experienced in obtaining thin and uniform microscope sections for detailed anatomical study.

(*d*) Anatomical study of the woods of the family Dipterocarpaceae was continued. Timbers which did not respond properly to the treatment of HF were re-treated and sections of a number of them were successfully cut and mounted.

(*e*) Anatomical study of the woods of the family *Meliaceae* was continued. Twelve specimens of *Cedrela toona* from various localities were cut and mounted.

(*f*) Anatomical study of the woods of the family *Lauraceae* was interrupted due to lack of staff.

(*g*) Anatomical investigation of Indian spruce and fir for finding out their suitability as aircraft material was further continued.

(*h*) Work on the determination of the rate of diameter growth of *Terminalia myriocarpa* and *Duabanga sonneratioides* in the dead and dying areas in Sadia

Division, Assam was continued. 108 micro-blocks collected for this study were all cut and mounted. Necessary micro-chemical and anatomical data were collected for analysis.

(*i*) The study of relation between height and diameter growth in some trees in the pole stage was started in the Silvicultural demonstration area. A number of cuttings for microscopical study was taken out from *Araucaria cunninghamii*, *Hovenia dulcis*, *Melia azedarach* and *Michelia champaca*. All sections were cut and micro-chemical tests carried out. Necessary anatomical data were collected for each species. The collection of data was completed and the results were being analysed.

(*j*) To study the effect of girdling on growth activities of *Shorea robusta* (sal), 10 micro-blocks were taken out from girdled trees (Timli Range, Dehra Dun division) for microscopic examination. The experiment had to be given up due to severe attack by insects.

Identification of woods

The Branch was busy throughout the year in examining a large number of timber samples both in the form of finished articles and raw material which were sent by the Army, Air Force and other Government Departments, and various industries of the country. Identification was done and necessary advice was given regarding substitutes and suitability of timbers for specific purposes. Information was also supplied regarding availability and uses of timbers. The most important enquiries were received from M/s. Plywood Products, Sitapur; M/s. Ahlowalia & Co., Delhi; M/s. Nathu Lal Shivnarayan Gattani, Jalgaon; M/s. Garden Reach Works Ltd., Calcutta; M/s. Pestonji Jamasji & Co., Bombay; M/s. United Scientific Industries, Ludhiana; M/s. Jamuna Plywood, Dehra Dun; Mr. Gilbert U.S.A.; M/s. Hindustan Plywood Ltd., Cannanore; M/s. Orissa Plywood Industries, Cuttack; Assam Railway & Trading Co., Ltd., Assam; Forest Utilisation Officer, Madras; M/s. Dhansiri Saw Mills Ltd., Assam; M/s. Phoenix Plywood Co. Ltd., Kottayam (South India); "WIMCO" Factory South India; M/s. A.R.M.C. Mowjee, Calcutta; Chief Commerical Manager, Bengal & Assam Railway; M/s. Malabar Plywood Works, Feroke; M/s. Dhanamall Silk Mills, Varachha Road, Surat; M/s. Travancore Plywood Industries, Ltd., Pulanur; Mine Manager, C.P.; Manganese Ore Co; The Conservator of Forests, Working Plan and Survey Circle C.P. & Berar, Nagpur; M/s. C. Lazarus & Co., Ltd., Calcutta; M/s. Sunderdas Saw Mills, Bombay; Indo-Iraq Trading Co., Bombay; G.I.P. Railway Workshops, Matunga, Bombay; Hyderabad State (Deccan); M/s. Standard Wood Products, Yesvantpur; M/s. Sirsilk Ltd., Mascret Manzil, Abid Road, Hyderabad Dn.; M/s. Hind Provincial Flying Club, Lucknow; D.F.O. Ranchi Division, Bihar; M/s. Birla Jute Manufacturing Co. Ltd., Calcutta; The Garrison Engineer, RIN/RIAF, Tambaram; M/s. Addison & Co., Ltd., Bangalore; M/s. South India Plywood Industries, Kottayam; M/s. United Importer Corporation, Bombay; M/s. Champaklal & Co., Billimora and the Conservator of Forests, Sirmour State.

During the year altogether 1626 timber specimens were identified.

Special enquiries and defects in timbers

The important items handled under this head are given below :—

(1) The examination of archaeological specimens sent by the Director-General of Archaeology in India from the Harappa Excavations (2000 B.C.) was continued. The results appear to be very interesting. A short note on the timber so far identified has been sent to the press. The final report is under preparation.

(2) The examination of an ancient wood, said to be from sacrificial stand (2nd Century A.D.), which was received from the Director-General of Archaeology in India, has been completed and a note has been sent to the Director-General of Archaeology for his perusal and remarks.

(3) Examination of 110 *Terminalia tomentosa* poles sent by the Central Silviculturist for finding out whether these would produce figured wood. All the samples came from poles which were raised from seeds collected from figured laurel trees. The examination at this stage of growth did not reveal any figure. There was no heartwood formation and no twist of any significance could be traced in them.

(4) The examination of 18 samples of *Melia indica* sent by Officer in charge Timber Testing Section for finding out the reason for marked difference in their strength values. The microscopic examination revealed that very poor strength figures were not due to any serious anatomical defects but was mainly due to very heavy attack of fungus. The samples which gave very high strength data were free from fungus attack.

(5) A large number of pulp sheets prepared with mechanical pulp of *Sterculia campanulata* from the Andamans, was examined to find out the reason for low "burst factors" and "breaking length". On microscopic examination it was found that peculiar shape of ultimate fibres and bad fungus attack might have been responsible for the two defects mentioned above.

(6) Samples of *Sterculia alata* received from the Andamans were examined under the microscope with special reference to their suitability for mechanical pulp. In comparison with *Sterculia campanulata*, *Sterculia alata* appeared to be better for the production of mechanical pulp.

(7) Eight discs of *Sageraea listeri*, which showed considerable variation in their impact bending test results, were received for anatomical study and finding out the reason for erratic behaviour. Microscopic examination revealed the following reasons for variation in strength :

(*a*) Presence of mucilaginous fibre.

(*b*) Heavy deposits in parenchyma cells and rays.

(*c*) Variation in the rate of growth.

(*d*) Thin-walled fibres.

(*e*) Fungus attack.

(8) Examination of wood of *Trema orientalis* to find out its suitability for mechanical pulp, was completed.

(9) D.F.O. Kalimpong Division, West Bengal, wanted to know whether locally grown *Cryptomeria japonica* wood would be suitable for the manufacture of mechanical pulp. It was not possible to give a definite reply. The samples examined showed a great variation in anatomical structure and rate of growth. Further investigation will be necessary to draw final conclusions.

(10) A large number of splints and veneers of *Sterculia campanulata* were examined from normally grown forest trees and also from trees from regeneration areas in the Andamans. The Western India Match Company declare the wood from regeneration areas as useless for matches. A comparative microscopic study was made and it was found that the samples from regeneration areas were composed of very thin-walled fibres and very thin parenchyma cells. Further material will have to be examined with a view to drawing a definite conclusion on the suitability or otherwise of this material.

(11) Examination of wood of *Holoptelea integrifolia* for finding out its' suitability for mechanical pulp was completed. From anatomical point of view it did not appear to be very good but from other considerations a trial was recommended. This enquiry was received from the Conservator of Forests, Western Circle, U.P.

(12) The Forest Research Officer, Orissa, wanted advice regarding suitability of *Ailanthus excelsa* and *Melia composita* for mechanical pulp for newsprint manufacture. Microscopic examination showed that *Melia composita* was a better material for trial than *Ailanthus excelsa*.

Indexing of permanent slides and photomicrographs

About 554 permanent slides were prepared and filed in the collection of authentic slides. This includes both foreign and Indian timbers.

150 photomicrographs were added to the collection during the year.

Collection of authentic wood specimens

(*a*) *From India* : 6 authentic wood samples from different provinces were added to the Institute standard collection.

(*b*) *From abroad* : The total number of wood specimens added to the foreign collection was 100. These were from Florida, Ohio, U.S.A. and Singapore F.M.S.

Distribution of wood specimens

In response to requests both from Civil and Military sources 849 wood samples were supplied to enquirers.

Training

During the year, courses of instruction in timber identification were held as in previous years and the following officers and others were trained :—

(1) Military personnel (M.E.S.)	7
(Defence Department)	1
(2) Apprentices	2
(3) Representatives from Plywood Factories	3

(4) Representatives of Timber Merchants	..	..	1
(5) Forest Officers from Provinces and Ceylon		..	3
(6) Other Institutions and Colleges	..	..	2

Dr. K. A. Chowdhury took both theoretical and practical courses in Wood Technology in the Indian Forest College and Indian Forest Rangers' College.

Instructions in Wood identification to the M.E.S. personnel, apprentices and others was given by Mr. S. S. Ghosh.

Tours

(1) In March Dr. K. A. Chowdhury attended a meeting of the Cellulose Research Committee called by the Department of Scientific and Industrial Research at Delhi.

(2) In July the Wood Technologist visited Tinli forest in connection with the girdling experiments of sal.

(3) In connection with the study of the woods of the family *Dipterocarpaceae*, Mr. S. S. Ghosh, Assistant Wood Technologist, visited the Royal Botanical Garden, Calcutta. The entire Dipterocarp collection was examined and necessary data collected for various genera and species.

(4) Dr. K. A. Chowdhury, who was elected President of the Botany Section of the Indian Science Congress, attended the Session at Patna and presided over the deliberation of the Botany Section.

(5) Mr. K. N. Tandon, Research Assistant, went on tour to Bihar to collect micro-blocks and field data in connection with the study on the effect of girdling on growth activities of Indian trees.

Publications

The following publications were issued during the year :—

1. Dr. K. A Chowdhury & S. S. Ghosh, 1946 .. Some More Commercial Timbers of India. *Indian Forest Records* (N.S.) Vol. 4, No. 3 (In press).

2. Chowdhury, K.A., 1947 Initial Parenchyma Cells in Dicotyledenous Woods. *Nature* 160 (4070) 668-9 London.

3. Chowdhury, K.A., 1948 Some Aspects of Pure and Applied Wood Anatomy. *Proc. Indian Science Congress*, Patna. 35 : 1-20 3 Pls.

CHAPTER VI

WOOD WORKING AND TIMBER MECHANICS BRANCH

On the splitting up of the Utilisation Branch the following sections were grouped together to form a new branch, called the Wood Working and Timber Mechanics Branch :

1. Wood Working Section.
2. Timber Testing Section.
3. Mechanical Engineering Sub-Section.

Dr. S. N. Kapur Officer in charge of the Wood Working Section was placed officer in-charge of the newly created Branch, with the following staff :—

1. Mr. V. D. Limaye, Officer-in-charge, Timber Testing Section.
2. Mr. Sultan Mohammed, Officer-in-charge, Wood Working Section.
3. Mr. S. M. Hussain, Assistant Officer, Timber Testing Section.
4. Mr. B. L. Saksena, Mechanical Engineer.

The partition of the country adversely affected the staff of this branch. Mr. Sultan Mohammed finally opted for Pakistan and left on 1st November 1947. It has not been possible to fill up that place so far with the result that next to the Officer-in-charge of the Branch the senior most technical man in the Wood Working Section is the Head Carpenter, who is not even literate. A number of highly qualified and expert workmen in the Mechanical and Wood Workshops also left for Pakistan and it has not been possible to fill up their posts with artisans of the same high degree of skill.

Reorganisation Scheme

Most of the equipment provided in the re-organisation scheme for the 3 sections of this Branch is on order with the D.G.I & S. A few machines for the Mechanical Workshops have come. Some small machinery for the Wood Workshops is also expected shortly, but it will be two to three years before the procurement and installation of the major items are completed. No extension to the workshop building could be carried out during the year, on account of disturbed conditions in the area.

Wood Working Section

The research investigations carried out during the year are briefly described below :—

(1) *Textile Mill Wooden Accessories.*—The imports of bobbins and shuttles required by Textile Mills in the country amounted to Rs. 1,22,50,011 in 1945-46. Figures for other wood-ware items are not available, but with general increase in prices and better facilities for imports after the war, India is spending not less than Rs. 2 crores per annum abroad for the purchase of wooden stores for the textile industry. Much of this money can be saved to the country, if the manufacture of bobbins and shuttles is properly developed, but it would require considerable field work to improve the methods of manufacture, introduction of few timbers, proper conversion and seasoning of blanks etc. Unfortunately

staff for this purpose is extremely inadequate. Some progress has however, been made in the manufacture of jute mill bobbins at Calcutta. Various factories were visited early in 1917, when the manufacturers were advised regarding the proper methods of air-seasoning in the form of rough-turned and rough-bored blanks. A number of factories have been following this practice with the result that the quality of their out-turn has distinctly improved.

The greatest difficulty is, in the supply of timber. The Calcutta manufacturers are almost entirely dependent upon mango, which comes from village lands, and for which species there is a big demand for plywood, packing cases and other uses. As plywood manufacturers are able to pay higher prices, the material available to bobbin manufacturers is naturally poor Supply of mango is becoming scarce as during and after the war, trees were ruthlessly cut down in villages on account of the money they brought. It is high time that other timbers are introduced and arrangements made with the Provincial Forest Departments and the Railways for making an adequate supply of suitable timbers available in Calcutta.

Special strength tests.—Haldu, mango, and other timbers used at present have the drawbacks that they are somewhat brittle and easily break when the bobbins fall from a height. Before suggesting new species, it was considered necessary to determine the relative strength under impact across the grain of the species likely to be suitable for the purpose. The 'Izod' machine in the Timber Testing Laboratory had to be changed to make it suitable for this test, and tests are now in progress.

Manufacture of 3-ply ends.—Another important change made in the manufacture of 3-piece built up bobbins is the introduction of 3-ply ends. The timber is sawn into $\frac{1}{2}$ inch thick planks, cut into pieces 6″ × 6″ and then glued with casein cement to the normal size of 6″ × 6″ × 1$\frac{1}{2}$″ and worked in the same manner as solid ends. A large scale investigation will be carried out in co-operation with the Indian Jute Mills Association, Calcutta, to find out the actual life in service of bobbins with 3-ply ends, for which the necessary material is being prepared at Dehra Dun.

Pre-shrunk shanks.—To improve the joint between the shank and the two end pieces, it has been found that if the shanks are dried to a low moisture content of say 6 to 8 per cent at the time of actual fitting, the joints become tight after manufacture and remain so during service. This procedure will also help in improving the quality of Indian made 3-pieces jute mill bobbins

Indian Standards for Textile Wooden Stores.—The Indian Standard Institution took up the question of laying down standard for wood-ware items required by the Textile mills in the country and the Textile Division Council of the Institution appointed a Sectional Committee to go into the question. The first meeting of the Sectional Committee was held in Bombay on March 2nd, 1947, when two sub-committees were appointed, one for the jute mill wooden stores to hold its meetings, in Calcutta, and another for cotton, silk and woollen mill wooden stores to have its sittings in Bombay. A questionnaire was issued to various manufacturers to elicit information regarding the present state of the industry. It is hoped that during 1948-49, tentative standards for various

stores will be adopted, which will help the manufacturers and consumers greatly in getting the correct type of stores.

(2) *Furniture and cabinet making.*—Various new items were prepared for display at the Forest Research Institute and various exhibitions in the country. Particular mention may be made of 4 designs of chairs in plywood, which are strong, serviceable and cheap and which should find a ready market if produced on a commercial scale. Plywood trunks and suit cases, laminated arms for upholstered chairs, laminated desks, dining tables, centre tables and many other articles of furniture are greatly appreciated by visitors to the Institute, many of whom want to purchase such items, but we cannot refer them to any source of supply at present.

(3) *Pencils.*—Treatment with wax and dyes of suitable species is in progress *Hymenodictyon excelsum* has given fairly good results. The investigation is being continued.

(4) *Penholders.*—An investigation is in progress with a leading firm in Calcutta, to find out timbers suitable for this industry. Out of 13 timbers tried, the following have been declared suitable :—

(*i*) *Adina cordifolia, haldu.*

(*ii*) *Stephegyne parvifolia, kaem.*

(*iii*) *Hymenodictyon excelsum, baurang.*

(*iv*) *Gmelina arborea, gamari.*

(*v*) *Holarrhena antidysenterica, kurchi.*

(5) *Hockey sticks.*—An investigation has been taken in hand to find out suitable timbers for the manufacture of hockey sticks, for which mulberry was being used at Sialkot, now in Pakistan. A number of timbers have been obtained, and trials are being carried out in co-operation with the Wood Seasoning Branch.

A number of samples of laminated hockey sticks with Goodyears' Pliobond glue have also been prepared. These will be sent to the Indian Military Academy and other institutions for service trials.

(6) *Plywood flooring.*—A parquette floor in sissoo and rosewood plywood was laid down in one of the rooms in the Timber Museum. It is so far doing well.

(7) *Working qualities of Indian timbers.*—Tests on the working qualities of the following species were carried out during the year—

(*i*) *Populus ciliata.*

(*ii*) *Melia azedarach.*

(*iii*) *Broussonetia papyrifera*

(*iv*) *Vatica lanceaefolia.*

(*v*) *Aquilaria agallocha.*

(*vi*) *Aglaia species.*

(*vii*) *Tectona grandis.*

(*viii*) *Prosopis spicigera.*

(8) *Miscellaneous investigations* The following items are worth mentioning :—

(*i*) Wooden springs for upholstered chairs.

(*ii*) Cricket bats of *Michelia champaca* and *Sapium sebiferum*.

(*iii*) Curtain rings of plywood.

(*iv*) Laminated wheels for a hand cart.

(*v*) Dyeing of veneers.

(*vi*) Use of '*Blanchit*' for bleaching of dark coloured woods. Very good effect was obtained on *sissoo*.

(*vii*) Laminated pulleys for machine shafts

(*viii*) Bamboo knitting needles.

(*ix*) Bleaching of cane.

and (*x*) Wooden insulated flask.

(9) *Tours* : Dr. S. N. Kapur, was on tour in Calcutta from January 26th to February 18th where he visited a number of Wood Working Industries. He also attended the first meeting of the Sectional Committee on Textile Stores of the Indian Standard Institution at Bombay on March 2nd.

(10) *Routine* : The following items may be mentioned :—

(*i*) For the Composite Wood and Wood Preservation Branch, 19,197 glue adhesion test specimens were prepared.

(*ii*) For the Wood Technology Branch, 1,279 hand specimens were prepared and supplied.

(*iii*) For the Timber Testing Section 3,996 tests specimens were prepared.

(*iv*) For the Wood Seasoning Branch 3,486 blanks and 36 bobbins of various species were prepared.

(*v*) Repairs and maintenance work for all Branches of the Institute was done. The total number of jobs carried out was 641.

(*vi*) In the sawmill, 4,430 c. ft. of timber was converted during the year.

(11) *Training was given to the following* :—

(*i*) One batch of six forest officers (Assistant Conservators of Forests) from the U. P.

(*ii*) 4 batches of M.E.S. Personnel.

(*iii*) Forest Utilisation Officer, Sind.

(*iv*) Two apprentices from outside.

(12) *Enquiries* - More than 100 enquiries were dealt with during the year by correspondence, in addition to numerous personal enquiries made by the visitors to the Branch

Timber Testing Section

Mr S. M. Hasnain, the Assistant Timber Testing Officer remained on leave for a period of about 8 months from July 1947 to February 1948. The post of the Lower Assistant No. 1 which had fallen vacant, remained unfilled throughout the year. The post of one machine operator, who had opted for Pakistan, also remained vacant. Three of our experienced computors were transferred to the newly created Statistical Branch. It is found as a result that computing work is suffering and arrears are piling up.

The following is a short resume of work done in the Timber Testing Section during the year.

Testing of tea-chests

Comparison of 8 and 12-batten types.—Plywood tea-chests of imported as well as Indian manufacture were formerly made with 8-battens, four at each end, the long vertical edges of the side panels being rivetted to the metal corner strips with bifurcated rivets. During the war, however, the difficulty of obtaining bifurcated rivets necessitated the introduction of 4 more battens along the longer edges for strengthening tea-chests. An investigation was, therefore, undertaken to compare the strength of the 12-batten type tea-chests with the 8-batten type.

For this purpose, tea-chests were obtained from the Assam Saw Mills and Timber Co., Ltd., Murkong Selek and from the Assam Railways and Trading Co., Ltd., Margherita. Altogether 150 tea-chests of 8 & 12-batten types of three well known brands were tested.

The 12-batten types of tea-chests was seen to be considerably stronger in every respect than the 8-batten type. It does not require any bifurcated rivets as only wire nails are used to fix the sides. The addition of four battens relieves the plywood panels of a major portion of stresses due to hazards which would otherwise have to be borne by the plywood.

Effect of reducing the thickness of plywood panels used for making tea-chests.—Plywood tea-chests are generally made of 3/16" thick plywood panels. It was observed that the use of 4 additional battens showed a general increase in the strength of the tea-chest, and it was thought a short reduction in the thickness of plywood panels may still give a strong enough tea-chests, while a certain economy may be effected in timber consumption. The idea was passed on to the Assam Saw Mills & Trading Co., Ltd., who readily agreed to manufacture four different types of tea-chests, made with 3/18" thick panels and 12-battens, were sufficiently strong and compared favourably with the imported tea-chests of birch plywood. Reducing the thickness of panels from 3/16" to 3/18" with 12-batten construction was, therefore, recommended. This would economise the timber requirements of plywood by about 10 to 12 per cent.

Testing of tea-chests submitted by private firms.—19 tea-chests were sent for testing by M/s. Jamuna Plywood Products Co., Dehra Dun. The plywood panels had *toon* for face veneers and mango for cores. Twenty tea-chests of 3-ply *gurjun* were sent for testing by Messrs. Wood Crafts Products Ltd., Cooch Behar. Ten tea-chests made of vellapiney (*Vateric indica*) plywood

were sent for testing by M/s. South Indian Plywood Industries, Kottayam. The tea-chests were tested and reports were sent to the respective firms.

Testing of tool handles.—The following species were tested to find out their suitability for making hammer handles :

(*i*) *Sageraea listeri* from Andamans.

(*ii*) *Gardenia turgida* from Bombay.

(*iii*) *Gardenia latifolia*, from C. P.

Sageraea listeri, and *Gardenia turgida* gave good results and are found to be suitable for all kinds of handles. The tests on *Gardenia latifolia* were not satisfactory as the material was very defective. It, however, seem to be a good species for making lighter types of handles if proper selection is made.

Check tests on aircraft material.—Two consignments of aircraft spruce from Messrs. Indian Air Survey and Transport Ltd., and one consignment from Messrs. De Haviland, Karachi, were received for check test in order to examine if the material was in good condition. The material was tested according to specification D.D.T. 36B and test certificates were issued to the firms.

Testing of glue joints submitted by ground engineers.—Consignments of glue joints prepared by applicants for ground engineers licence examination were received for report during the year. These tests are done on behalf of the Civil Aviation Directorate. Certificates of tests were issued after testing the joints.

Testing of glues and adhesives.—Eighty three consignments consisting of synthetic resin-bonded plywood, compregnated wood, lap joints, saw dust boards, fibre boards, etc., were received for testing from the Composite Wood and Wood Preservation Branch in connection with their research programme.

Three consignments of glue joints were received from the Wood Workshops.

All consignments were tested and results supplied.

Effect of corrosive chemicals on timber.—Twenty four lots of cypress specimens treated with different chemicals were received for testing from the Wood Seasoning Branch in connection with their research programme. Test results are supplied.

Design of a timber foot bridge.—A timber foot bridge of 40 ft. span and 6 ft. width for crossing a canal was designed for the Permanoor Sawmills, Ernakulam, Cochin, and a drawing was supplied.

Exhibits.—The following exhibits demonstrating the work of the Timber Testing Section were prepared for sending out to various exhibitions in the country :

3 boards, graphically illustrating comparative suitability of various important Indian timbers.

3 boards, representing Indian timbers suitable for making various types of tool handles.

2 sets of wooden disc dowel joints suitable for timber structures.

2 models of a 40 ft. span timber roof truss, made with wood disc dowel joints.

1 set of full-sized typical joints for a 40 ft. span timber roof truss.

Demonstrations of and instructions in timber testing work to visitors and students.—The following parties visited the Timber Testing Laboratory during the year and were given demonstration of work done in the Timber Testing Laboratory. Some were given short courses of individual training.

1. M.E.S.° personnel from Roorkee.
2. Ordnance personnel.
3. Members of the Indian Road Congress.
4. P.W.D. staff.
5. Students of the Indian Forest College.
6. Students of the Indian Forest Ranger College.
7. Parties of gentlemen cadets from the Indian Military Academy.
8. Individual demonstration to a number of distinguished visitors including the Hon'ble Minister for Food and Agriculture, Central Government, Secretaries to Government, Minister of Agriculture, Madras; Representatives of Plywood Manufacturers and others.

Lectures.—The Officer-in-charge, delivered lectures on the properties and utilisation of timber to students of Engineering College and Engineering bodies at Poona, Bombay and Banaras.

Regular testing work.—Testing under Project I (Testing of small clear specimens) for determining fundamental strength properties of Indian timber species was done as the time permitted.

The following table shows the volume of testing work done in the Timber Testing Laboratory during the year :—

Project.	Green	Consignments air dry	Kiln-dry.
I	11	7	6
6	17	125	26

The total number of mechanical tests done during the year was about 13,500.

The total number of physical determinations done during the year was about 3,250.

Total testing work done up-to-date.

Project	Green	Consignment dry	Kiln-dry
1	239	219	211
2	96	88	..
3	..	4	2
4	..	52	..
0 (All sub-heads	590	3,352	619

The total number of mechanical tests done up-to-date is about 4,70,500. Total No. of physical determinations done up to date is about 4,97,500.

'Computation of test data.—About 10,300 computations of test data were done during the year in addition to preparing strength tables etc., for sending out to enquirers. About 12,000 computations of shrinkage, moisture and specific gravity determinations etc., were also done.

About eighty technical notes and report on various subjects such as tool handles, timber trusses and bridges, tea-chests, air-craft timbers, plywood etc., were issued during the year.

Mechanical Engineering Section.

The following machines were received during the year but the erection work could not be undertaken as the extension of the Workshop buildings by the Central P.W.D. has yet to be taken up.

1. Screwing machine for pipes and bolts,
 Makers—Kendall and Gents. Ltd., Manchester.
2. Small Vertical Drilling Machine,
 Makers—Cooper Engineering Ltd., Satara.
3. Gas Welding Plant,
 Makers—M/s. Thom. & Hoddle Ltd., London.
4. Precision Universal Milling Machine,
 Makers—M/s. The Victoria Machine Tool Co., Ltd., London.

A room for the gas welding plant has been built, but the plant is not yet in operation as a licence for the storage of calcium carbide has to be obtained.

CHAPTER VII

WOOD SEASONING BRANCH

The Wood Seasoning Section of the old Utilisation Branch was converted into the Wood Seasoning Branch from 20th May 1947. The charge of the Branch was held by Mr. M. A. Rehman throughout the year, except for a period of one month and ten days, when Dr. S. N. Kapur, Officer-in-charge, Wood Working and Timber Mechanics Branch held charge of the Branch in addition to his own duties.

Work on the following items was carried out during the year under report.

1. *Kiln drying.*—Thirty-five charges of timber were kiln seasoned during the year. These included the experimental charges of very refractory as well as non-refractory timbers. Several consignments of sticks were seasoned for strength tests in the Wood Working and Timber Mechanics Branch. More than a dozen kiln charges were dried for general use in the Wood Workshops.

Two inch thick boards of *Cynometra polyandra* (*ping*) were kiln seasoned from 35% to 10% moisture content in 40 days, working the kiln 12 hours a day. It is very slow drying timber, liable to surface cracking and end-splitting. Similarly *Dipterocarpus indicus* (*kalpine*) was found to be one of the slowest drying timbers. It is also liable to surface cracking.

The rapid kiln drying behaviour of two packing case timbers, *viz.*, *Kydia calycina* (*pula*) and *Anthocephalus cadamba* (*kadam*) in one inch thick planks was studied. It was found that both could be dried rapidly without any defects. *Pula* was seasoned from 155% to 10% moisture content in 11 days and *kadam* was dried from 98% to 10% moisture content in 8 days, working the kiln for 12 hours a day in both cases.

Several charges of sal were dried including 1½" thick boards which were dried from 60% to 18% moisture content in 21 days of 12 hours each, the timber got crooked and developed some surface cracks also.

Sticks of about a dozen species were seasoned or conditioned to 12% moisture content for strength tests and for the nail pulling tests by the Timber Testing Section. *Soymida febrifuga* was found to season slowly and to develop surface cracks. In case of *Buchanania latifolia* the pin knots and the original heart shakes opened out. The sticks of *Zanthoxylum rhetsa* showed a certain amount of surface cracking and end-splitting, and heart shakes had extended.

More than a dozen charges of mixed timbers were dried.

The veneers of *Garuga pinnata* (*garuga*), *Lannea grandis* (*jhingan*), *Lophopetalum wightianum*, *Sonneratia apetala* (*keora*), *Kydia calycina* (*pula*) and *Buchanania latifolia* were seasoned, and the veneers of about a dozen species of woods were conditioned to 8% and 12% moisture contents for the Composite Wood and Wood Preservation Branch. Out of the above, the veneers of *jhingan* buckled badly, though there was not much cracking.

The blue prints of kilns for seasoning timber, veneers, and bobbin and shuttle blanks were supplied to 35 enquirers including the Conservator of Forests, Colombo and M/s. British American Tobacco Co., Batavia (Java). One

internal fan kiln for seasoning of shuttle blanks and another for the conditioning of semi-finished shuttles was designed for M/s. The Indian Shuttle Co. Ltd., Bombay.

2. *Air seasoning and girdling.*—Detailed tests on the air seasoning behaviour of two very refractory woods, *viz* , *Anogeissus latifolia* (axlewood) and *Cynometra polyandra* (*ping*) in the form of 2" thick boards were carried out. The timber was stacked for seasoning at four different times of the year, *viz.*, in the months of March, May, July and December 1947. It was noticed the timber stacked for seasoning in the months of March and May dried very quickly but developed deep surface cracks in almost all the planks. The timber stacked in December was slightly better but the planks stacked in July dried slowly and only 20% of these suffered from cracking and splitting.

The results show that these woods can be satisfactorily seasoned if they are converted in rainy season and immediately stacked for air drying in sheds.

The best method of air drying bobbin blanks was investigated. It was observed that the rough turned pre-bored bobbins of *Mangifera indica* (mango) and *Stephegyne parvifolia* (*kallam*) dried from green condition to about 15% moisture content within a week without any appreciable degrade. This has been found to be the best method of drying bobbin timbers. The bored and un-bored, but unturned, half-wroughts 6"×3"×3" in size, of the same timbers took two to three weeks to dry.

The un-bored blanks of *kalam* showed 50% rejections, and those of mango were all rejected due to end-splitting at the end of seasoning process. The bored pieces gave slightly better results but even these were much worse than the half-turned pre-bored pieces.

The test on the air seasoning of material obtained from girdled and ungirdled trees of *Tectona grandis* (teak), *Xylia xylocarpa* (*irul*), *Hopea parviflora* (*hopea*) and *Ougeinia dalbergioides* (*sandan*) was completed and the final observations were taken. There was no appreciable difference between the two lots of planks.

The final observations, after air seasoning, on the planks obtained from girdled and ungirdled trees of *Pterocarpus marsupium* (*bijasal*) were taken. The boards, 1½" in thickness, took about six months to dry, and no appreciable difference in the condition of material obtained from the two lots of trees was noticed. The timber though refractory can be satisfactorily seasoned if given protection from sun and hot winds.

The girdling test on sal started in the Dehra Dun Forest Division was stopped as the girdled trees were attacked by a harmful pest.

Another girdling test on *Anogeissus latifolia* (axlewood) *Terminalia tomentosa* (laurel) and *Pterocarpus marsupium* (*bijasal*) has been started in Bihar.

3. *Timber physics.*—(Investigations into the physical properties of wood).

(*a*) *Shrinkage and moisture absorption studies.*—The tests on shrinkage, welling and moisture equilibrium of wood at various relative humidities were carried out on several species of woods. The moisture absorption by panels of seasoned wood was studied on *Mansonia* sp.. teak, *sissoo* and rosewood.

(*b*) *Effect of corrosive chemicals on physical and mechanical properties of wood.*—The detailed investigation into the effect of corrosive chemicals on wood with the object of finding Indian woods for the chemical industry was continued.

The results of tests carried out in co-operation with the Govt. Central Distillery, Nasik on about a dozen species of Indian woods for kegs (for maturing whisky) as a substitute of imported oak, have shown that after six months of storage, *Terminalia tomentosa* (laurel), heartwood, is the best of the lot, and *Shorea robusta* (sal) comes next. The rest, *viz.*, *Tectona grandis* (teak), *Ougeinia dalbergioides* (*sandan*), *Artocarpus hirsuta* (*aini*), *Grewia tiliaefolia* (*dhaman*), *Anogeissus latifolia* (axlewood), *Acacia arabica* (*babul*), *Lagerstroemia lanceolata* (*nana*), *Quercus dilatata*, *Quercus semecarpifolia*, and *Lagerstroemia flos-reginae* (*jarul*) imparted a bitter taste and dark colour to the whisky.

Further tests were carried out by emptying out the contents and refilling the kegs with fresh whisky for maturing. It was found after a few months, that all the timbers except *Tectona grandis* (teak) and *Ougeinia dalbergioides* (*sandan*) gave good results. Teak and *sandan* imparted a peculiar smell.

(*c*) *Moisture proofing efficiency of paints.*—Further tests on the moisture proofing efficiency of seven samples of paints sent by M/s. Jenson and Nicholson (India) Ltd., Calcutta, were carried out. The best paint gave an efficiency of 95% when the painted panels were exposed to a humid atmosphere of 92% relative humidity at 95°F temperature, in a constant humidity chamber for about 20 days.

4. *Industrial investigations.*—(Seasoning & suitability of Indian woods for various articles).

(*a*) *Textile and jute mill accessories.*—Various kinds of cotton mill bobbins of *Artocarpus chaplasha* (*chapalsh*) and *Chukrasia tabularis* (*chickrassy*) were manufactured by M/s. Indian Bobbin Co. Ltd., Bareilly, and sent to M/s. Victoria Mills Ltd., Cawnpore for service tests.

The seasoned blanks of seven species of Indian woods *viz.*, *Hymenodictyon excelsum* (*kuthan*), *Amoora rohituka* (*amoora*), *Anthocephalus cadamba* (*kadam*), *Mangifera indica* (mango) and *Holoptelea integrifolia* (*kanju*) were sent to M/s. Indian Bobbin Co., Bareilly, for the manufacture of different types of cotton mill bobbins for tests.

The report on the manufacturing quality of *Zanthoxylum rhetsa*, *Adina cordifolia* (*haldu*) and *Amoora rohituka* (*amoora*) for bobbin making was received from M/s. Indian Bobbin Co. Ltd., Bareilly. It has been reported that in all the three cases there is a higher percentage of rejection during manufacture in small sized bobbins than in those of bigger size. *Haldu* which is commonly used by Indian manufacturers did not behave better than the other two woods in manufacture.

The following report was received from M/s. Delhi Cloth Mills Ltd., Delhi, on the suitability of axlewood (*Anogeissus latifolia*) and *babul* (*Acacia arabica*) for picker arms :—

'We have pleasure to report that these picking sticks are as good as any foreign make. The sticks AL (*Anogeissus latifolia*) and AA (*Acacia arabica*)

were put on test during July 1942 and they broke on 24-5-1946, 2-4-1946, 9-5-1946 and 12-4-1947, *i.e.*, with an average life of more than three years.

We would ask you strongly to recommend these sticks to the various mills who are consumers for these types of picking sticks ".

(*b*) *Pencils.*—Several tests on the softening of wood for pencil making were carried out in co-operation with the Wood Working and Timber Mechanics Branch. A new technique of impregnating the pencil slats has given encouraging results ; details are being worked out.

(c) *Railway cushion pads.*—At the request of the Chief Engineer, B. N. Railway, railway cushion pads (to be used along with modified Duplex C I Rail Free Joint sleepers) made of about half a dozen species of woods were supplied for experimental purposes. The inspection report on *sundri* (*Heritiera minor*) has been received. The pads made of *sundri* were found in good condition after 5½ months of service.

5. *Bending of wood.*—No work could be done during the year, but the equipment for the bending of wood for hockey sticks has been set up. The following timbers are under seasoning for testing their suitability for hockey stick blades in co-operation with the Wood Working and Timber Mechanics Branch.

1. *Ehretia laevis* (*chamror*)

2. *Stereospermum suaveolens* (*padal*)

3. *Albizzia procera* (*siris*)

4. *Lagerstroemia parviflora* (*dhauri*)

6. *Education and Training.*—The Officer-in-charge delivered a series of lectures to the students of Indian Forest College on seasoning of wood.

The work of training the apprentices sent by various Government Departments and the timber trade was continued. The Forest Utilisation Officers of Sind and Ceylon, and a Forest Officer from Assam were given short courses of training in the seasoning of wood. Six Forest Officers from U.P. took a refresher course in the seasoning of timber. One Professor from the Bengal Engineering College and one Officer from Army Headquarters took short courses of training in the technique of seasoning of wood. Eight M.E.S. Officers were trained in the methods of handling, storage and seasoning of wood. A chemist from M/s. Western India Plywood Co., Baliapatam was trained in the method of seasoning veneers and plywood. One Officer of the Govt. Central Wood Working Institute, Bareilly paid a visit to study the latest developments in kiln drying technique. A Sleeper Passing Officer, of the Eastern Group Sleeper Control, came to collect information on the seasoning of railway sleepers.

An apprentice from M/s. Delta Bobbin Co., Calcutta and two other apprentices took a complete course of training for 3 months in the seasoning of wood.

7. *Enquiries.*—A number of enquiries on the air and kiln seasoning of timber, installation and designs of seasoning kilns, seasoning and suitability of Indian woods for shuttles, bobbins, picker arms, pencils, battery separators, vats for storage of acids and alkalies etc., were dealt with. Visits were paid by the officers and the staff of the Branch to the forests in Madras, Bihar and the U.P.. to take observations in connection with the tests on the girdling of trees.

8. *Publications* (i) Rehman, M A , and Ishaq, S.M., 1947. Seasoning and Shrinkage of Bamboo. *Indian Forest Records*, (N.S.) (Utilisation), Vol. 4, No. 2. pp. 35.

CHAPTER VIII

COMPOSITE WOOD AND WOOD PRESERVATION BRANCH

Dr. D. Narayanamurti held charge of the Branch throughout the year. Dr. Ranganathan rejoined the Branch in June 1947 after about 18 months overseas training. During the year Dr. Narayanamurti was appointed as a member of the technical sub-committee on Wood Chemistry of the F.A.O.

The following items of work were investigated :—

Preservatives

Examination continued of the sal saplings treated with different varieties of creosote and installed in the graveyard. The results were in agreement with earlier observations. The data accumulated during the past 8 years have been analysed and it is hoped that it will be possible to issue a publication on the subject during the coming year A few experiments were also carried out on the oxidation of creosote.

In view of the encouraging results obtained in the laboratory on the preparation of pentachlorophenol, experiments on a pilot plant scale were taken up. A small plant from materials readily available in the laboratory, was constructed. The reaction vessel consisted of a small iron drum lined with synthetic resin, a wooden cover carrying a cooling coil, inlet and outlet for chlorine, stirrer, etc. The reaction vessel was also provided with a glass window. About 2½ lbs. of phenol were charged in the reaction vessel and the yield of crude pentachlorophenol was about 6¼ lbs. On analysis the yield as pure pentachlorophenol amounted to 70%. It is believed that this can be improved.

In addition to the above, two samples of furnace oil from the Burmah Shell Co., samples of oils and fractions from the Naharkatiya Plant, sample of Hardiproof and a sample of Phenyl-Mercury Fixtan were examined.

Fire Resistance

As remarked in last years report the mechanism of fire retardant action was investigated both from the chemical and physical points of view. For the chemical work saw dust impregnated with the fire retardant was used. This was charred at about 600°C in a combustion chamber after evacuation. The rate of evolution of the gas was noted on a manometer and at the conclusion of the carbonisation process the gas collected was analysed for the following constituents—

Carbon monoxide, carbon dioxide, oxygen, hydrogen and methane. The work is being continued.

On the physical side the heat penetration in untreated and treated veneer packs was studied. Two methods of heating were adopted, *viz.*, hot plate and infra red radiation. In the hot plate experiments the results obtained were not always consistent. This is being examined. The experiments using infra red radiation as the source of heat were only few in number but they indicate that the rate of temperature change in packs treated with fire retardants is less than with untreated packs.

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Thermal Properties, etc.

As work on thermal expansion of wood and composite wood gave inconsistent and curious results it is proposed to take up further experiments on the subject only when improved apparatus is ready.

Some experiments on the penetration of heat into timber when exposed to infra red radiation were done. In these preliminary tests it was noticed that the rate of rise of temperature is not only dependent on the density of the timber but also on its colour and other factors. Thus, though *semul* (*Bombax malabaricum*) is lighter than sal (*Shorea robusta*) which is also heavier than *toon* (*Cedrela toona*) the time taken for the centre of specimens of the same dimensions to rise to the same temperature was about the same. 90-98 minutes for the conditions of the test. In the case of mango it was 130 minutes and with mulberry it took 150 minutes. The reflecting power to infra red radiation of various species was also investigated. In these tests which involved the study of over 100 species the light from a G.E.C. infra red lamp was directed on the piece under investigation and the reflected radiation measured by means of a Moll thermopile It was noticed that generally a lighter shade timber had higher reflectivity If the reflectivity of the black body used was 5, that of ebony was 16 and that of *Cryptomeria japonica* was 31·5.

The influence of other factors, *viz*., the angle of incidence etc. are being investigated.

Permeability

The permeability to air of *Dillenia indica*, *Michelia* sp., *Machilus* sp. *Mitragyna* sp. and *Zanthoxylum rhetsa* was investigated. The *Michelia* and *Machilus* species were very resistant.

With a view to investigating the mechanism of the movement of gases in wood a manostat and an absolute manometer were constructed and the permeability determined at various absolute pressures of the incoming gas.

Towards the close of the year experiments on the permeability of wood to ions, neutral molecules etc. were started. Permeability cells of perspex were constructed and a few experiments on the permeability of *salai* (*Boswellia serrata*) to boric acid were done. It is proposed to do extensive experiments on the subject during the coming year.

Other Physical Properties

Among other physical properties investigated may be mentioned the damping capacity of wood both in the natural and treated states, and elastic constants of plywood by vibrational methods. The damping capacity of *Anthocephalus cadamba* (*kadam*), *Pinus longifolia* (*chir*) *Zanthoxylum rhetsa*, *Diospyros* sp., *Pterocarpus macrocarpus* (Burma padauk), *Chickrassia tabularis* (*chikrassy*), *Salix tetrasperma* (*willow*), *Tectona grandis* (teak), *Adina cordifolia* (*haldu*), *Dendrocalamus strictus* (*bamboo*), *Bombax malabaricum* (*semul*), *Terminalia tomentosa* (laurel), *Mangifera indica* (mango), *Cedrela toona* (*toon*) and *Dalbergia sissoo* were investigated. Bamboo, mango, *semul*, laurel and *sissoo*

had high coefficients while padauk and chickrassy had low coefficients. Treatment with water or preservative liquids was found to increase the damping coefficient. The influence of oil type and water soluble preservatives is being investigated. The damping coefficient was found to be higher in 45° specimens.

The Young's modulus in bending and rigidity modulus of various species of plywood were determined by vibrational methods. About 20 species were studied. The boards included commercial samples as well as samples prepared in the branch. $43{\cdot}45 \times 10^9$ dynes/sq. m was the lowest value and $271{\cdot}1 \times 10^9$ dynes/sq.m. was the highest obtained for Young's modulus along the grain. If the ratio of the modulii along the grain to across the grain is considered this varied from 3 to 34, it varying from 5-15 in the majority of the cases. The Young's modulus of *Dysoxylum malabaricum* plywood was found to be higher for urea resin bonded plywood than for Tego bonded plywood. This is probably due to the strengthening effect of the urea resin as it was in liquid form. In the rigidity tests the values obtained varied from 2×10^9 to 7×10^9 dynes/sq.m. and the effect of species and grain was not much in most cases, the ratio of the rigidity modulii across and along the grain varying by not more than 25%. But in the case of *Terminalia belerica* plywood samples tested, this ratio was about 2, with the same species the ratio of the Young's modulii along the grain to across the grain was also very high. *viz.* about 34.

Corrosion of Metals by Wood

During the year under review the corrosion of metal by wood at about 75°C was investigated. About 12 species including *Dichopsis elliptica* (*pali*), *Zanthoxylum rhetsa*, *Dalbergia sissoo* (*sissoo*) and *Adina cordifolia* (*haldu*) were used for the tests. As is to be expected there was acceleration in corrosion at this temperature. Iron and lead were mainly attacked. These experiments suggest a possible inhibition period. The products of corrosion probably catalyse the reaction. It was also noticed that corrosion was excessive where two dissimilar metals were in contact. Extensive experiments on the mechanism of corrosion are envisaged during the coming year.

Treating Processes

In view of the remarks made in last year's report on the *Terminalia tomentosa* (laurel) sleepers treated after conditioning by the Boulton process, large scale experiments were undertaken. 2,000 sleepers from Madras were used in these experiments and they were treated at the Mysore Government Wood Preservation Plant at Bhadravati. The moisture content of the sleepers at the time of treatment was about 50%. The processes adopted were: (1) steaming and vacuum process of conditioning followed by the Full Cell process and (2) steaming and vacuum *cum* Boulton process of conditioning followed by the Full Cell process. The absorption of the preservative (50 : 50 mixture of creosote and fuel oil) varied from 2·1 to 5·4 lbs./c. ft. as estimated by tank level readings. The sleepers will be laid half in a wet zone of the South-Indian Railway near Bagavatipuram and the other half in a dry zone in the M. & S. M. Rly. near Rodigunta. The behaviour of these sleepers will be watched with interest

The treatability of *Cedrela toona* (*toon*) was also investigated. 'Green M. G. sleepers were used for the experiments. The Boulton as well as the steaming and vacuum processes of conditioning were tried Some sleepers were treated after air seasoning. The absorption obtained varied from about 0·9 lbs. to over 20 lbs./c. ft. Sapwood was completely penetrated, in the heartwood side penetration was very little, and penetration amounted to 1—2" and there was some oil in the pores adjacent to the annual rings.

On behalf of a firm in S. India the treating characteristics of *Grevillea robusta* in the open tank were investigated. Satisfactory penetration was obtained in these cases.

On behalf of the Defence Department a few experiments on short open tank schedules for the treatment of army timbers were conducted. The species tried were : *Acacia arabica* (*babul*), *Anogeissus latifolia* (*bakli*), *Pinus longifolia* (*chir*), *Canarium* sp. (*dhup*), *Abies* sp. (*fir*), *Adina cordifolia* (*haldu*), *Dipterocarpus*, sp (*gurjan*), *Mitragyna parvifolia* (*kaim*), *Terminalia tomentosa* (laurel) *Mangifera indica* (mango), *Morus* sp. (*mulberry*), *Calophyllum* sp. (*poon*), *Shorea robusta* (sal), *Boswellia serrata* (*salai*), *Ougeinia dalbergioides* (*sandan*) and *Dalbergia sissoo* (*sissoo*). The schedules adopted were (1) hot bath of 15 minutes followed by cold bath of 15 minutes (2) hot bath of 30 minutes followed by cold bath of 30 minutes, and (3) hot bath of 1 hour followed by cold bath of 1 hour. For the sizes used and purposes to be served the second schedule appeared to be satisfactory.

A few experiments were also done on the vapour conditioning process with *Dichopsis elliptica*, *Albizzia procera*, *Zanthoxylum rhetsa*, and *Cedrela toona*. Further detailed tests will be carried out during the coming year. Among other timbers treated in the plant may be mentioned : *chir* paving blocks, bamboos and specimens for accelerated service tests.

Service Tests

The following were installed in the graveyard for accelerated service tests :

1. Holoplast samples.
2. Treated cotton felt.
3. Plimber boards.
4. Treated plywood (Ascu and creosote).
5. Hardiproof.
6. Phenyl Mercury Fixtan.
7. White-antrin.

Adhesives

Work on the adhesive developed from cashew nut shell liquid was continued. Condensation with formaldehyde both in presence and absence of phenol effect of various solvents, like solvent naptha etc. were tried. In the manufacture of 'compreg.' with this adhesive, steam pockets gave trouble. This

was got over by making the veneers protrude out of the platens of the press. However the strength values obtained were not as good as with phenol formaldehyde.

The price of casein during the year went up over Rs. 6,000/- a ton and the demand for substitutes was very acute. In view of this, towards the close of the year work was started on possible sources of proteins for adhesives. Among these may be mentioned blood albumen, proteins of *Lathyrus sativa* and proteins of leaves. Whole blood was dried in a kiln at 50°C and powdered and used for the experiments. Satisfactory adhesives could be prepared from the whole blood meal and in addition to the usual formulae for blood albumen glues other formulæ were also tried with satisfactory results. Work was also initiated on leaf proteins for plywood adhesives. Preliminary experiments with leaves of *Aesculus indica* appear promising.

Tests on the storage life of Aerolite 306 mentioned in last year's report were completed. In all, the tests were done for 18 months. During this period no corrosion of the container was noticed. The solubility and condition of the powder were satisfactory throughout as also the glue adhesion. Taking into account that the temperatures are low for about 5 months in the year in Dehra Dun the results indicate that a minimum storage life of about a year can be easily expected for the adhesive in this country.

Tests on the storage life of Tego glue film in "Bran" packing were also undertaken. Twenty four rolls were received for these tests and one roll was opened each month and plywood made with veneers of *Cedrela toona*, *Mangifera indica* and *Dysoxylum malabaricum* and the boards were tested. The film was received on 11-3-47 and was first tested in May 1947 and then every month till June 1948 and again monthly tests started in April 1948. At the end of 8 months storage adhesion was satisfactory, as indicated by the glue adhesion strength tests, dry as well as hot wet. But there was an increase of glue failure especially after the 6th month.

In addition to the storage trials, plyboards using Tego film were prepared with the following twenty five species: (1) *Zanthoxylum rhetsa*, (2) *Dichopsis elliptica*, (3) *Dipterocarpus* sp. (4) *Dalbergia sissoo*, (5) *Dalbergia latifolia*, (6) *Polyalthia* sp., (7) *Populus euphratica*, (8) *Boswellia serrata*, (9) *Pinus longifolia*, (10) *Lannea grandis*, (11) *Bombax malabaricum*, (12) *Butea frondosa*, (13) *Bauhinia lanti*, (14) *Mitragyna parvifolia*, (15) *Litsaea* sp., (16) *Garuga pinnata*, (17) *Dipterocarpus macrocarpus*, (18) *Terminalia myriocarpa*, (19) *Albizzia procera*, (20) *Polyalthia fragrans*, (21) *Terminalia paniculata*, (22) *Machilus* sp., (23) *Artocarpus hirsuta*, (24) *Vateria indica* and (25) *Acrocarpus fraxinifolius*. Several of the boards have been tested and of these only with *Dipterocarpus* sp., was there glue failure; in all other cases there was wood failure and the results were satisfactory both in the dry and hot wet tests.

A few preliminary experiments on the viscosity of prolamin solutions using the Goodeve thixo-viscometer were carried out. In these experiments it was found that the viscosity increased with age; while a 5% dispersion was stable upto nearly a week, a 20% solution gelled in about 24 hours, the influence of rate of shear on the viscosity of the solutions etc., is being studied.

In view of the non-availability of pentachlorophenol the use of "Alfloc" (which consists of Sodium pentachlorophenate, alkali and binding materials) was investigated for the protection of glues and plywood. Addition of Alfloc to Madison formula as well as modifications of the Madison formula taking into account the alkali content of Alfloc were tried. It was found that the dry strength of the adhesive was reduced while the water resistance was not affected.

Tests were also undertaken on the following adhesives received from M/s. I.C.I., Ltd. (1) U. F. Syrup 232, (2) phenolic glue P.G. and (3) Resin R_1. The U. F. Syrup was tested for gap joints as well as for plywood, the following species being used for making plywood: (1) *Dysoxylum malabaricum*, (2) *Cedrela toona*, (3) *Mangifera indica*, (4) *Dichopsis elliptica*, (5) *Zanthoxylum rhetsa*, (6) *Polyalthia* sp., and (7) *Mitragyna parvifolia*. The phenolic glue resin R_1, which was a two stage phenolic resin, did not give as good results as glue P.G.

Three types of synthetic resins (P. F.) received from M/s. Indian Plastics Ltd., Fort, Bombay were tested.

Two samples of synthetic resin adhesives received from M/s. I.F. Lauks were also tested with satisfactory results.

During the year under review a number of enquiries including some from Finland, Canada and Sweden were received regarding the prolamin adhesive developed at the Institute. It is hoped that during the coming year at least some firms will start manufacture of prolamin.

Plywood

Various types of plywood made by using Tego film, I.C.I. urea formaldehyde syrup 232, etc., were tested for tensile, bending and compression strengths and panel shear. The results are being analysed.

Setting of adhesives

The work on the influence of psychrometric conditions on the setting time of adhesives was completed. In these tests casein and Aerolite glues were used. The curves showing the relation between setting time and humidity were different in shape for casein and Aerolite. The casein one resembled the equilibrium moisture content curve for casein. With Aerolite above 70% the humidity did not have any great influence.

Various methods of accelerated setting of adhesives were investigated. A welding transformer was obtained and the low voltage strip heating method investigated for not only the preparation of laminates but also for the production of plywood. Casein, ground nut protein formaldehyde, blood albumen, aerolite, phenol-formaldehyde and cashew nut shell liquid adhesives were tried. In all cases satisfactory results were obtained. As far as it is known the method has not been employed for the setting of phenolic glues, it being mainly used with intermediate temperature urea glues. For the production of resin bonded plywood a simple press using a screw jack for giving pressure was constructed at a low cost and strip heating adopted. In these experiments it

was noticed that there was localised heating in some places. This was overcome by placing an aluminium caul on the assembly, with the side in contact with the heated strip coated with a thin layer of insulating material. Plyboards giving good adhesive strength could be prepared and it appears that this method could compete favourably with the more conventional methods.

The use of H. F. heating for making plywood and laminated assemblies was also investigated on a small scale Laminated bends using phenolic glues could be easily made. While it took 2 to 3 hours for making a similar bend by strip heating the same could be done in 7-20 minutes with H. F. P. F. bonded plywood was also successfully made with H. F., contrary to reports from other quarters. It was however noticed that higher values were obtained in the hot wet tests than in the dry tests suggesting spot welding.

A simple method of curing resin adhesives developed during the year, was " open tank curing ". In this method laminates with phenolic resin after clamping were put in a creosoting tank and subjected to the normal open tank process. It was noticed that this resulted in curing the adhesive film and in some cases there was a simultaneous treatment of the timber. Very good results were obtained and in several cases when tested the joints failed in the wood. It is proposed to investigate this method for the production of large laminated members.

Laminated Wood

In response to a request from M/s General Motors Ltd. Laminated roof corners for their lorry bodies were produced with satisfactory results. Ground nut protein, Aerolite and phenolic resin were the adhesives used. Some were cured by the low voltage strip heating method and others by H. F. These corners are found to be alright at the end of about 2 months soaking in water.

The laminated *sissoo* picking sticks sent for trials were reported to have behaved satisfactorily by the mills : and they stated "the laminated picking sticks are definitely better than the standard hickory picking sticks and have a working service life twice as long as the latter."

Work on the production of laminated sleepers etc. was also undertaken.

Compregnated Wood

Compregnated wood made from different species and resins during the previous year were tested. During the year compregnated wood from *Albizzia procera* was made. Compregnated wood was also made with cashew nut shell liquid but the results obtained were not as good as desired. Further work on the use of cashew nut shell liquid resin for production of compregnated wood is being undertaken.

Insulation Effects on Aircraft Wings

Observations on the synthetic resin bonded Horsa Tail unit, parts of Horsa main plane, section of Mosquito fuselage and section of Hornet wing were continued. The synthetic resin bonded units are still in good condition. The main planes installed at Cochin were examined, and were found to be in an advanced stage of deterioration.

Weathering Tests on Phenoglaze, etc.

Specimens of eleven species of wood painted with phenoglaze, etc., were weighed and their dimensions measured at periodic intervals. The phenoglaze painted specimens continue to be in satisfactory condition. The Styrofort painted specimens had further deteriorated. If the weight changes (which is an indication of the moisture absorption and desorption) during the period are considered, the greatest variation between minimum and maximum was noticed with Styrofort painted specimens. This amounted to 12·8% with *Abies* sp., and 5·68% with *Pterocarpus dalbergioides*. With Phenoglaze clear treated specimens, the value amounted to 10·02% with *Adina cordifolia* and 1·48 with *Pterocarpus dalbergioides*. With PH grey, the highest value was 8·23 with *Cryptomeria japonica* and the lowest 2·94 with *Pterocarpus dalbergioides*, *Phoebe* sp., *Pterocarpus dalbergioides*, *Pterocarpus macrocarpus*, *Cedrela toona* and *Morus* sp. showed lower figures of absorption.

The use of these paints for the protection of wood against the corrosive action of chemicals was also investigated. The chemicals used were : Sulphuric acid (5% and 20%), hydrochloric acid (5% and 10%), nitric acid (5% and 10%) and caustic soda (5% and 10%). None of the paints afforded protection against caustic soda. Protection was obtained against the acids in the following order, sulphuric, nitric and hydrochloric. The Phenoglaze paints offered more protection than Styrofort.

Insulation and other Boards

Work on the utilisation of Areca nut husk was continued and the results so far obtained written up for publication.

Work on boards from saw dust was also carried out with interesting results. The addition of various binders was tried, *viz.*, phenolic resin, prolamin-formaldehyde, ground nut protein formaldehyde, blood albumen or a combination of these, varying from about 5% to 25% on the weight of the saw dust. Boards comparing very favourably with foreign samples were prepared. The highest tensile strength obtained was about 9,000 lbs./sq. in. In bending the modulus of rupture varied from about 4,000 to 9,000 lbs./sq. in. The boards can be used for building and other purposes.

Towards the close of the year experiments were also undertaken on the utilisation of bamboo for building boards. Bamboo mats soaked in phenolic resin were pressed together with or without addition of saw dust. The boards so produced had good strength and other properties suitable for building and other purposes. Using low voltage strip heating and ordinary wooden moulds and clamps corrugated boards suitable for roofing were also produced. It is proposed to build a small hut with these materials for service tests.

Education and Training

The Officer-in-charge gave a series of lectures on wood preservation and composite wood to the students of the Indian Forest College.

One Chemist from Western India Plywoods, Baliapatam underwent a course of training on various aspects dealing with adhesives and composite wood.

The Timber Adviser to the M.G.O. spent a few weeks in the Branch.

Publications

During the year the following publications were either sent to the press or got ready for publication.

1. Preservative Treatment of Bamboo. Part I—Treatment of green bamboos with inorganic preservatives by D. Narayanamurti, A. Purushotham and J. N. Pande (Indian Forest Bulletin No. 137).

2. Note on treated wooden transmission poles in India by D. Narayanamurti (Indian Forest Bulletin No. 140).

3. Preliminary studies on Improved wood. Part IV—Impregnation of Wood with urea-formaldehyde resins, by D. Narayanamurti and J. George.

4. A preliminary Note on Indian substitutes for beech in B. S. S. 4 V2 tests, by D. Narayanamurti and G. D. Dagg.

5. Studies on the storage life of adhesives. Part I—Tego Glue-film, by D. Narayanamurti and J. N. Pande.

6. Studies on Adhesives Part X--Adhesives from Castor Seed Cake and its proteins. by D. Narayanamurti and G. D. Dagg. (Indian Forest Leaflet No. 100).

7. Studies on Adhesives Part XI—Adhesives from Cashew nut shell liquid by D. Narayanamurti and N. C. Jain.

8. Studies on Adhesives Part XII —A preliminary note on Cresol-formaldehyde and Cresol-casein-formaldehyde adhesives for plywood, by D. Narayanamurti, V. Ranganathan and O. P. Agarwal (Indian Forest Leaflet No. 97).

9. Durability trials on glues and plywood, by D. Narayanamurti and J. N. Pande (Indian Forest Bulletin No. 139).

10. Corrosion of wood by Hot Chemicals, by D. Narayanamurti and V. Ranganathan. (Indian Forest Leaflet No. 101).

11. Utilisation of Areca nut husk waste. by, D. Narayanamurit, V. Ranganathan and J. George.

Tours

The following tours were undertaken by officers of the Branch during the year.

1. The Officer-in-charge attended (1) the enquiry into the plywood industry conducted by the Indian Tariff Board at Ootacamund in May 1947 as the representative of the Forest Research Institute, (2) a meeting of the Patent Advisory Committee in Delhi in June 1947 in connection with the exploitation of the patent on prolamin, and (3) two meetings at the end of February and early in March 1948 in the Deptt. of Agriculture, New Delhi in connection with the more extended use of treated timber.

One of the Assistant officers went to Cochin in August 1947 to take observations on the main planes installed there.

The Officer-in-charge and one of the Assistant officers attended the Indian Science Congress in Patna in January 1948.

The Officer-in-charge and the Lower Asstt. went to Bhadravati in March 1948 in connection with experiments on the treatment of green laurel sleepers. The Officer-in-charge also visited the plywood industry etc., in Bangalore and Madras.

CHAPTER IX.

CELLULOSE AND PAPER BRANCH

1. *Newsprint quality paper from Broussonetia papyrifera and bamboo pulp.*—Our pilot paper machine was not quite suited to the production of newsprint quality paper, particularly as it lacked the reeling equipment. A bulk quantity of mechanical pulp was prepared (on the pilot grinder) from *Broussonetia papyrifera* (paper mulberry) and sent to M/s. Shree Gopal Paper Mills, Abdullapur, along with the required quantity of bleached bamboo (*Dendrocalamus strictus*) pulp for conversion into reels of newsprint quality paper. Two reels of this paper having a furnish of approximately 70% mechanical pulp and 30% chemical pulp, each 35" wide and 30" in diameter, were sent from Abdullapur to the Statesman Press, New Delhi, for a printing trial on the high speed rotary press. The general behaviour of the reels under normal running conditions and the colour of the paper was reported to be good by the Works Superintendent, Statesman Press. He, however, reported that the paper was thicker and of a softer quality than the Canadian newsprint and comparatively less calendered, necessitating a greater supply of printing ink. Although the tensile strength of the paper was found to be as good as that of the imported paper, the web broke at different tensions, due to the varying thickness of the paper.

Further experiments are in progress on the production of mechanical pulp from *Broussonetia papyrifera* from which newsprint quality paper could be prepared, which would be free from the flaws observed in the course of the printing trial at the Statesman Press.

2. *Bleached papers from cotton wastes from textile mills.*—Investigations on the utilisation of cotton wastes (cardfly Nos. 1 and 2 and gutterfly) for the production of white writing and printing papers were completed and report made to the Director, Technological Institute, Indian Central Cotton Committee, Bombay, at whose instance the investigations were undertaken. Samples of paper made on the pilot paper machine have also been supplied to him. The investigations show that the wastes are an excellent source of raw materials for use in the manufacture of superior qualities of papers.

3. *Pulp and paper from sabai grass (Eulaliopsis binata).*—At the instance of M/s. The Star Paper Mills,—experiments have been undertaken to investigate (1) the relative advantages and disadvantages of digesting cut and uncut grass and (2) causes of the low yield of paper from grass exploited from the Saharanpur Forest Division.

4. *Newsprint quality papers from Sterculia campanulata and Sterculia alata. Sterculia campanulata (papita)* and *Sterculia alata (letkok)* received from the Andamans were ground into mechanical pulp in bulk quantities. Newsprint quality paper having a furnish of 70% mechanical pulp from the two species and 30% bleached bamboo pulp was run on the pilot paper machine. The paper produced was very poor in strength properties, probably due to the fact that both the woods were found to be badly attacked by the fungi when received at Dehra Dun. Fresh consignments of the two woods, free from fungus and borer attacks, have been requisitioned from the Andamans for repeating the tests.

5. Nearly 2 tons of bleached bamboo pulp was prepared for carrying out experiments on the comparative retentivity and opacity in papers of China Clay and Talc.

6. White paper, which would not go back in colour on storage was prepared for the printing of Silviculture Manual and supplied to the Oxford University Press, Calcutta.

7. The total quantity of various kinds of papers, boards, etc., supplied during the year to the various offices in the Forest Research Institute and Colleges, to Government and other printing presses for Institute publications and to other Government Departments amounted to a little more than 14 tons.

Laboratory

1. Experiments to fix conditions of digestion for preparing ' kraft' pulp from *Pinus longifolia* (*chir*) saplings have been completed.

2. Investigations on the recovery of magnesia from spent liquor obtained in the sulphite digestion of bamboo, started early in the year, were suspended, as the chemist to whom the problem was assigned opted for Pakistan.

3. Samples of drawing papers were examined for stability, under different atmospheric conditions for the Survey of India.

4. Chemical analysis of two samples of teak wood was carried out by an assistant from the Wood Technology Branch.

5. Preliminary examination to test the suitability of the following broad-leaved species of woods for the production of news-grade mechanical pulp was carried out at the request of Dr. Ing. Milos Krofta, Milano, Italy :

1. *Mangifera indica.*
2. *Ailanthus excelsa.*
3. *Bombax malabaricum.*
4. *Alstonia scholaris.*
5. *Ficus glomerata.*
6. *Buchanania latifolia.*

6. Analysis of samples of limestones from the Lachhiwala forests, for supply to M/s. Star Paper Mills, were carried out at the request of the Conservator of Forests, Western Circle, U.P.

7. Experiments were carried out on the grinding of *Acacia decurrens* for the production of mechanical pulp. The pulp produced under different conditions had poor strength properties and the experiments were discontinued. Experiments on the production of semi-chemical pulp for use in the manufacture of wrapping papers have been taken in hand instead.

8. At the instance of M/s. Shree Gopal Paper Mills tests were carried out on *Broussonetia papyrifera* and *Populus euphratica* to test their suitability for printing and writing papers.

9. Digestions were carried out on (*a*) Manilla hemp (*b*) Sisal hemp and (*c*) caroa fibre supplied by M/s. R. & W. Watson Ltd., Linwood. England, with a view to prepare pulps possessing high strength properties, comparable to those possessed by the samples of pulps supplied by the Scotch firm. Strength tests on Atlas insulation paper manufactured by the firm have also been carried out.

10. Strength and ageing tests were carried out on four samples of papers received from M/s. Shree Gopal Paper Mills and report made to the firm.

11. Determinations of percentage ash, copper number, pentosan and alpha cellulose content in samples of pulps sent by M/s. Shree Gopal Paper Mills were carried out and results furnished to the firm.

12. Routine analyses of boiler feed water, digestion chemicals, etc., were carried out as usual.

Enquiries.

Technical enquiries from Government Departments, Indian States and business concerns were attended to from time to time.

Tours.

1. In connection with the Re-organisation Scheme, Mr. M. P. Bhargava, Officer-in-charge, Cellulose and Paper Branch, was on deputation tour abroad from the 15th May to 8th November 1947. He visited a number of laboratories and research institutions, paper, board and cellulose mills and important pulp and paper machinery manufacturing firms in Sweden, Norway, United Kingdom, Canada and the United States of America. During this period he also attended, as a delegate, Sessions of the Fifth British Empire Forestry Conference held in England and also a few meetings of the International Congress of Pure and Applied Chemistry held in London.

2. The following tours were undertaken by the Officer-in-charge, Cellulose and Paper Branch :

(*a*) To Calcutta from 4th to 17th February 1948, to attend the meetings of (1) the Expert Committee on the Re-organisation Scheme (2) Technical Sub-Committee of the Advisory Committee (3) Advisory Committee of the Indian Paper Industry and (4) Standardization and Quality Control Conference, and

(*b*) To Delhi from 2 to 5th March, 1948, along with S. Chattar Singh, Assistant Paper Pulp Officer to attend (1) the printing trial of newsprint paper in the Statesman Press, New Delhi and (2) the interview by the Federal Public Services Commission for the selection of a candidate for the Senior Research Officer's post in the Branch.

Meetings.

1. A meeting of the Experts' Committee on the Re-organisation Scheme for the Cellulose and Paper Branch was held in Calcutta on the 9th and 10th February, 1948 to consider Mr. Bhargava's report on his foreign tour and make recommendations to the Government on the finalized scheme. The

Committee, after discussing Mr. Bhargava's report in detail passed the following resolutions :

"1. Whereas in the meeting held at Dehra Dun on the 17th and 18th October 1946, the scope and functions of the re-organised Cellulose and Paper Branch were considered and approved, this Committee reconsidered the various details in a meeting held on the 9th and 10th February 1948 in the light of Mr. Bhargava's report on his European and American tour and resolve to reaffirm their approval.

2. Whereas

(*a*) it is necessary in national interests to provide increased facilities for research and training in Pulp and Paper Technology;

(*b*) the facilities at present available at the Forest Research Institute are inadequate and out-of-date ; and

(*c*) Mr. Bhargava and Dr. Krishna were deputed by the Government of India to select and recommend proper equipment for the purpose after visiting Europe and America and Mr. Bhargava has now submitted his report;

this committee resolves that the pilot plant and laboratory equipment as appended (Appendix I and II) be installed at the Forest Research Institute as early as possible and recommends that necessary steps be taken to place orders of the same at an early date.

3. Whereas (1) the pevious estimates for the pilot plants were purely tentative, based on information then available and (2) in the light of visits and discussions overseas, the type of pilot plant now settled upon involves higher expenditure as ascertained from various manufacturers this Committee resolves that the increased expenditure is unavoidable and therefore recommends that the provisional estimates as revised and appended herewith (Appendix III) may be sanctioned by the Government so that orders for the various equipments and plant may be placed as soon as the final indent is prepared and approved of by the Committee.

4. Whereas, as recommended by the Paper and Rayon Panels, research on the preparation of celluloses for rayon and allied products from indigenous raw materials is to be undertaken at the Cellulose and Paper Branch, Forest Research Institute, Dehra Dun, and whereas for effective and complete investigations it is necessary to carry out reliable tests on the suitability of the celluloses prepared for the various end requirements the committee recommends the early procurement of the requisite laboratory equipments for the purpose.

5. Whereas, as recommended in resolution No. 2 above, it is desirable and necessary to place early orders for the various laboratory equipment and pilot plants and whereas it has not yet been possible to obtain firm quotations for these, the Committee resolve to appoint a sub-committee of three members *viz.*, (1) Dr. S. Krishna, Director of Forest Research, Forest Research Institute, Dehra Dun, (2) Dr. Schoenberg, General Manager, Shree Gopal Paper Mills and (3) Mr. Bhargava to take early and necessary steps to procure complete specifications and firm quotations for all the required equipment and to finalise the

indents so that orders for the same may be placed as soon as Government's sanction for implementing the Re-organisation Scheme is obtained."

1. The proceedings and resolutions of the Expert Committee have been submitted to the Government for approval and sanction of the Re-organisation Scheme.

2. Meeting of the Technical Sub-Committee and Advisory Committee of the Indian Paper Industry were held in Calcutta on the 10th, 11th and 13th February 1948. Report of work carried out in the Branch during 1947 was placed before the Technical Sub-Committee for discussion. Programme of work for the year 1948-49 was drawn up and approved by the Committee.

The Advisory Committee of the Paper Industry approved of the proceedings of the Technical Sub-Committee and passed the accounts for 1947-48 presented to the Committee by Mr. Bhargava.

The Committee also considered the resolutions of the Experts' Committee. They gave their general approval to them and recommended that they be adopted by the Government.

3. The Sub-Committee of the Central Advisory Board on Forest Utilisation in the meeting held on the 11th March 1948, reviewed the work carried out in the Branch since 1940 and approved of the programme of work as recommended by the Advisory Committee of the Indian Paper Industry. They also endorsed the resolutions passed by the Expert's Committee regarding the re-organisation and expansion of the Cellulose and Paper Branch.

Training of apprentices and Lectures.

One apprentice from Rohtas Industries Ltd., two from Sipur Paper Ltd., and one from Orient Paper Mills Ltd., completed varying periods of training during the year under report. Two apprentices from the Orient Paper Mills one of them a Government of Orissa nominee, joined the Branch in July 1947 and February 1948 and were still under training at the close of the year. The usual course of lectures was delivered to the Senior Class of the Indian Forest College.

Grants.

No contributions were received from the mills during the year under report. Both the Paper Makers' Association and Paper Mills' Association have, however, resolved to revive the voluntary contribution to the Institute with effect from the 1st October, 1947.

Publications.

1. Bhargava, M. P. and Chattar Singh, 1947. Interim report on the pulping qualities of crushed and uncrushed bamboo chips. Indian Forest Bulletin No. 127.

2. Bhargava, M. P. and Batra, P.C. 1947. Report on the discolouration of bleached bamboo and grass pulps during storage. Indian Forest Bulletin No. 128.

3. Bhargava, M. P. and Chattar Singh, 1947. A comparative study of some Indian China Clays as paper fillers. Indian Forest Bulletin No. 134.

Visitors.

1. Shree Jairamdas Daulatram, Minister for Food and Agriculture, Government of India.

2. Mr. L. T. Edwards, Managing Director M/s. Oscar Kohorn (India), Ltd.

3. Members of the Central Advisory Board on Forest Utilisation.

4. Mr. L. C. Bingham, Industrial Adviser to U. P. Government.

Miscellaneous.

In connection with the division of assets, consequent on the partition of India, lists of office equipments, plant and machinery tools, apparatus, stores etc., were prepared and submitted to the President, Forest Research Institute and Colleges.

Two chemists from the Branch opted for Pakistan. One chemist (S. Kartar Singh), who went abroad in December 1946 as a Government Scholar has not returned yet. The staff in the Branch was therefore considerably depleted, especially as the Officer-in-charge was also out for nearly half the year.

CHAPTER X.

CHEMISTRY & MINOR FOREST PRODUCTS BRANCH

The following programme of work was undertaken during the year under review :—

A.—*Essential oils*—

(*i*) *Saussurea lappa* C. B. Clarke—for costus oil in perfumery.

(*ii*) *Juniperus* sp.—for juniper oil in medicine and industry.

(*iii*) *Ocimum* sp.—for camphor.

(*iv*) *Putranjiva roxburghii* Wall.—for mustard oil in seeds.

(*v*) *Castor oil distillate*—for preparation of aromatics.

B.—*Resins and gum-resins*—

(*i*) *Boswellia serrata* Roxb.—for gum-oleoresin in varnishes and plastics.

(*ii*) *Altingia excelsa* Noronha—for uses of the resins.

C.—*Oils, fats and waxes*—

(*i*) *Mallotus philippinensis* Muell. Arg.—for highly drying fatty oil.

D.—*Pectins, gums and mucilages*—

(*i*) *Tamarindus indica* Linn.—for pectin from seeds.

(*ii*) *Asparagus filicinus* Buch.-Ham.—roots as a sizing material.

E.—*Tanning materials*—

(*i*) *Tamarind-seed coat.*—for dyeing and tanning substances.

(*ii*) *Cassia auriculata* Linn.—for collection of bark.

F.—*Drugs*—

(*i*) *Strychnos nux-vomica* Linn.—for effect of storage on seeds.

G.—*Miscellaneous*—

(*i*) *Monographs*—

(*a*) Aromatic Plants of India.

(*b*) Poisonous Plants of India.

(*ii*) *Inquiries.*

(*iii*) *List of publications.*

A.— Essential oils

(*i*) *Saussurea lappa* C. B. Clarke—It was reported last year that the yield of essential oil from the roots of *Saussurea lappa* was higher by solvent extraction method than by steam distillation, and that the oil also differed in physical and chemical characteristics from the steam-distilled oil.

The following fractions were obtained when the solvent-extracted oil was distilled under reduced pressure ; the fractions isolated were of the same range

as reported by Feldstein & Semmler (1914. *Ber.*, p. 2433) in the case of steam-distilled oil :—

B p at 11 mm pressure	Solvent Extracted oil			Optical rotation
	Yield %	Sp. gr. 20°	Refractive index	
(1) 60°1–50° .. .	3·8	0·9130	1·4820	+15·0°
(2) 150°–160°	1·8	..	1·4845	+16·8°
(3) 160°–175° .	B·1	0 9361	1·4382	+16·4°
(4) 175°–190° .	6·8	0·0981	1·5020	+19·4°
(5) 190 –200° ..	11·9	1·0118	1·5108	+25.6
(6) 200°–210°	28·0	1·0725	1·5150	+30°
(7) 210 215	16·6	1·0805	1·5200	+27·2°
Residue	10·0	..	..	..

The above results show that the solvent-extracted oil is very rich in high-boiling fractions and poor in low-boiling ones.

As was reported last year, during the course of vacuum distillation of the oil a colourless crystalline solid congealed in the condenser and receiver between the boiling point of 180° and 200° at 11 mm. This solid, after isolation and purification, was found to be a lactone, $C_{15}H_{20}O_2$, m.p. 145° to 147°. The presence of a solid lactone in the roots has not been noticed by previous workers. Its further studies will be undertaken when sufficient amount has been collected.

(*ii*) *Juniperus* sp.—In continuation of the work on juniper oil, samples of berries from two species, *viz.*, *J. macropoda* Boiss. and *J. squamata* Buch.-Ham., were obtained from Tehri-Garhwal. The quantity of the oils distilled from these was too small for a complete study. The physical characteristics were as under :—

	Yield %	Sp. gr. 20°	Refractive index	Optical rotation
J. macropoda	0·66	0·9006	1·4733	+44·5°
J. squamata	0 88	0·9266	1·4812	+32·5°

(*iii*) *Ocimum* sp. for camphor.—During the year under review a plot of about 1 acre of good land was planted with ocimum. This plantation was raised at the outset of the monsoon, from nursery seedlings. On account of conditions beyond our control, the harvesting of the crop was delayed and, therefore, a proportion of the lower leaves matured and fell down, thus decreasing the yield of leaves. The total yield of dry leaves was 644 lbs. in the acre of land. The second harvest would be ready for cutting late in May.

In order to ascertain the effect of different manurial treatments, 25 plots have been laid out and statistically treated with superphosphate, ammonium sulphate, farmyard manure and NPK mixture.

(*iv*) Mustard oils in the seeds of *Putranjiva roxburghii* Wall.—Last year the seeds of *P. roxburghii* were reported to contain mustard oils which were suspected to be two in number. A 40 gm. mixture of these (yield 0·5 per cent) was isolated from 8 kilos of moistened kernel powder by steam distillation. The mixture of mustard oils thus obtained was a sharp-smelling brownish-yellow liquid and had the following characteristics :—

Specific gravity 25°	1·0270
Refractive index 25°	1·5187
$[\alpha]_D^{25°}$ (5% concentration in alcohol)	+ 15°

36 gms. of the oil were fractionally distilled at atmospheric pressure and the following fractions were collected : -

Fraction	B. p.	Smell	Weight gm.	Sp. gr. $20°$	$[\alpha]_D^{25°}$	Remarks
0	Below 60° ..	..	1·2	..	..	Mostly ether sulphuric.
1	135°–145°	Strong mustard ..	18	0·9365	+ 10·9°	Boils mostly at 136°–138°.
2	145°–155°	Do. ..	10	0·9607	+ 20·0°	Boils mostly at 153°–155°.
3	155°–165°	Mustard repulsive	1·8	0·9900	..	Slight decomposition.
4	Residue ..	Repulsive ..	5	1·5102	..	Decomposed material.

From the fractions 1 and 2 *iso*propyl and *sec*-butyl mustard oils ($C_3H_7N{=}C{=}S$ and $C_4H_9N{=}C{=}S$) were isolated and were identified by their thiourea de i-

vatives ($C_3H_{10}N_2S$ m.p. 164°–165°, $C_5H_{12}N_2S$ m.p. 137°-138°) as well as by the chloroplatinates of their corresponding amine-hydrochlorides derived from them by hydrolysis with 20 per cent hydrochloric acid. In the fractions 3, phenyl mustard oil ($C_6H_5N=C=S$) has been identified by the preparation of its thiourea derivative ($C_7H_8N_2S$, m.p. 153°–154°).

Thus three mustard oils have been found to be present in the seed kernels, which presumably are the products of hydrolysis of sulphur glucosides present in the seeds. It is proposed to isolate and identify these glucosides. It may be pointed out that the characteristic strong mustard smell of the wetted kernel powder is due to the predominence of *iso*propyl and *sec*-butyl mustard oils and not to the presence of phenyl mustard oil (which forms only about 3 per cent of total mustard oil) as supposed by Dutt *et al.* (1916. *Indian Soap J.*, 11 : 169).

(v) *Preparation of aromatics from castor oil distillate.*—Products of distillation of castor oil being available from other sources, it was thought desirable to find out if any of their constituents could be made use of as a starting material for the synthesis of valuable aromatics. This is not an entirely new line of work, since previous workers have reported that the higher aldehydes prepared from heptaldehyde (one of the constituents of the distillate) possess agreeable odour. The distillate consisted of undecylenic acid (40 per cent) heptaldehyde (25 per cent), neutral compounds (30 per cent) and moisture (5 per cent). It was proposed to synthesize aromatic compounds from the undecylenic acid and heptaldehyde Preliminary experiments with heptaldehyde have already yielded a higher aromatic aldehyde of jasmine odour.

B.—Resins and gum resins

(i) *Boswellia serrata* Roxb.—A simple economic method of expressing the oleoresin from the gum-oleoresin under pressure at 120° to 130° in perforated vessel was reported last year. During the year under review, conditions for optimum yield were studied and it was found that the maximum yield of the resin (80 per cent of that present) was obtained when the gum-oleoresin lumps were reduced in size to 0·25" and heated for 4 hours at 120° under a load of 1·2 lbs. per sq. in.

The orange-yellow oleoresin was found to possess the consistency and transparency of Canada balsam. It could be decolorized with furfuraldehyde treatment. A 50 : 50 solution in xylene gave material with refractive index of N^D 1·5000 almost equal to that of ordinary glass and as such could be utilized for mounting slides.

(ii) *Altingia excelsa* Noronha.—This lofty tree occurs gregariously in Darrang districts of Assam and is plentiful in the evergreen forests of Eastern Assam. It yields a pale-yellow odorous resin in clear tears from clean wounds. The resin is considered similar to gum rasamala or styrax or storax from *Liquidambar orientalis* Mill. from Burma, Malaya Peninsula, Sumatra and Java. A sample of the resin from *A. excelsa* was received for examination from the Silviculturist, Assam, according to whom commercial quantities could be made available for exploitation With a view to finding it: suitability as a

substitute for storax or styrax its examination was undertaken and the following data recorded :—

Resin as received		Storax U. S. P.	Storax B.P.	Storax commercial
Resin (by 95 per cent alcoholic extraction) ..	93·15%			
Dirt (earth, bark, etc.) ..	4·85%			
Loss due to moisture ..	2·00%			
Loss at 100° for 2 hours. ..	4·33%	20%	5% (on water bath for one hour.)	
Ash	2·77%			
Acid value	46·0			
Resin extracted by alcohol.				
Melting point	90°—95°			
Specific gravity $^{20°}$..	1·046			
Acid value	58·3	36–85	55–90	70–90
Saponification value ..	105·4	160–200	170–200	135–180
Ester value	47·1	..	100–133	50–120
Cinnamic acid	absent	25% of storax	present	present
Soluble in alcohol, acetone, carbon-disulphide and ether.	(a little insoluble residue)	soluble in alcohol, ether, CS_2 and acetone		soluble in alcohol and ether

According to the above data and comparison of the same with B. P. and U. S. P. standards, the resin evidently does not resemble storax and cannot, therefore, be considered as a substitute for it. Its low melting point and its solubility in organic solvents as given above indicate that it might serve as a substitute for a softer type of resin like gum mastic, in varnishes.

C.—Oils, fats and waxes

(*i*) *Mallotus philippinensis* Muell. Arg.—The highly drying oil (kamala oil) from the seeds of *Mallotus philippinensis* on saponification and subsequent neutralization with hydrochloric acid was reported earlier to yield mixed acids, m.p. 51°–52°, m.w. 300, I. V., 136. These when separated into solid and liquid acids by Twitchells lead-salt-alcohol method, gave :—

Polymerized acids—	20%
Liquid acids—	31% I.V. 87–97.
Solid acids—	49% I.V. 107–119.

The formation of large amount of polymerized acids, insoluble in organic solvents, as well as the variations in the I. V. of liquid and solid acids appeared to be the result of rapid polymerization of the major constituent acids before saponification of the oil and during the Twitchells separation of the mixed acids. The liquid acids had already been found through their bromides to consist of oleic and linoleic acids. The solid acids were found to be unsaturated and were presumably acids of the *iso*oleic or other isomerized polyethenoid type. On exposure to air they soon got polymerized. They were separated into the following fractions for identification purposes :—

(*a*) 25% crystals from petroleum ether, m.p. 77°–78°, m.w. 280.

(*b*) 55% crystals from benzene, m.p. 77°–78°, m.w. 284.

(*c*) 10% benzene insoluble portion (polymerized).

(*d*) 5% portion soluble in petroleum ether.

(*e*) 5% portion soluble in benzene.

Fractions (*a*) and (*b*) were mixed, dissolved in 95 per cent alcohol and catalytically reduced with hydrogen in the presence of active platinum oxide for 3 hours. After the removal of the catalyst the products of reduction were isolated on concentration of the alcoholic solution as follows :—

(1) 40 per cent crystals m.p. 93°– 94°, I.V. 9, m.w. 305 (C 71·5 per cent; H 11·7 per cent; O 16·8 per cent; calculated for $C_{18}H_{36}O_3$ C 72 per cent, H. 12 per cent, O/16 per cent.)

(2) 15 per cent crystals from mother liquor m.p. 69°–70°, mixed m.p. with stearic acid unchanged.

(3) 45 per cent dark liquid acids I. V. 80, m.w. 280 from mother liquid of (2).

Fraction (c) being insoluble in organic solvents was not worked up further. Fractions (*d*) and (*e*) gave a small amount of acids melting at 55° and 56°, respectively, indicating mixtures of stearic with some lower acids.

Thus the mixed acids consist of 31 per cent oleic and linoleic acids, and 69 per cent of a C_{18} polyethenoid acid (I.V. over 100) which in contact with air is converted to a polymerized product to an extent of 20 per cent and the rest (49 per cent) is found to be oxygenated to some extent. On catalytic reduction with hydrogen this is converted partly to oxystearic (hydroxy or keto) acid, partly to a liquid acid (I.V. 80, m.w. 280) and partly to stearic acid. All this shows that the polyethenoid acid is really a mixture consisting of a C_{18} acid of the type of elaeostearic acid and it soxyderivative. It is proposed to separate these acids and then ozonize them to study the products of decomposition of the ozonides and thereby fix the position of the double bonds. Like elaeostearic acid these polyethenoid acids have the property of gelation when submitted to the action of heat.

D.—Pectins, gums and mucilages

(*i*) *Tamarindus indica* Linn.—The polysaccharide isolated from the tamarind-seed kernels, as reported last year, possesses the characteristic

property of forming acid-sugar-jellies just like the fruit pectins. Unlike the latter, however, it is not derived from polygalacturonic acid. Further, the carbohydrate is capable of forming jellies under varying conditions of pH, from 1·8 to 9·8. It does not, therefore, strictly come under the class of pectins, since, according to the present-day definition, pectins are methyl esters of polygalacturonic acid. Hence the term " Jellose " has been suggested, since it indicates both the carbohydrate nature and the jelly-forming property of the substance (*Chem. & Industr.*, 1946, **65** : 101).

It was reported last year that the jellose is essentially a carbohydrate which gives xylose, glucose and galactose on complete hydrolysis. When subjected to fermentative degradation, it yields a hexasaccharide with xylose, galactose and glucose in the molecular proportion of 2 : 1 : 3.

(*ii*) *Asparagus filicinus* Buch.—Ham.—It was reported last year that the root powder of *Asparagus filicinus* (*chiriya musli* or *nari musli*), when suspended in water, swells up almost immediately forming a thick, light-yellow, highly viscous solution. It was also shown that the powder could be successfully used as a printing base in calico-printing, in bulk-sizing in combination with tamarind-seed powder, and in the finishing of textiles. The chief constituent of the root powder is a carbohydrate present to an extent of 70 per cent. On acid hydrolysis, it yields glucose and mannose. It does not produce any furfural with hydrochloric acid but yields only a small amount of carbon dioxide indicating the presence of uronic acid. The substance, therefore, appears to be a mucilage composed of glucose and mannose, containing a very small amount of uronic acid.

E.—Tanning materials

(*i*) *Tamarind-seed Coat.*—The seed coat of tamarind, which forms nearly 30 per cent of the whole seed, is, as was mentioned in earlier reports, a by-products of the tamarind-kernel-powder industry. It has already been reported that it contains both dyeing and tanning substances; suitable methods of their utilization have also been suggested. Further investigations have shown that the tanstuff belongs to the catechol class of the depside group and is present to an extent of 16 to18 per cent of the testa. The colouring matter is a phlobatannin present to the extent of 10 to 12 per cent. The acetyl and methyl derivatives of the phlobatannin are optically active, lending support to the view that phlobatannins are probably hydroxyflavan derivatives.

(*ii*) *Cassia auriculata* Linn.—The bark of *Cassia auriculata* is a valuable tanning material. It is a shrub with thin branches and their debarking is a laborious process. The bark could be separated from the branches comparatively more easily during the growing season (summer) of the plant than in winter months. With a view to ascertaining the tannin content of the bark at a time when its separation from the branches is comparatively easier, monthly samples were obtained from the Etawah plantation. This work was

undertaken at the request of the Conservator of Forests, Land Management Circle, U.P. The results of analyses are given below :—

	Moisture	Total solubles	Non-tans	Tannin content
September	11·6	32·4	14·0	18·4
October	11·8	26·0	8·8	17·2
November	12·5	28·0	13·5	14·5
December	10·8	28·6	13·3	15·3
January	9·9	28·9	13·2	15·7
February	11·0	27·9	12·0	15·9
March	7·9	31·5	16·1	15·4
April	6·2	32·1	14·4	17·7
May	12·1	31·1	15·4	15·7
June	12·1	29·3	11·6	17·7
July	12·6	29·3	11·7	17·6
August	11·2	29·9	12·0	17·9

The variation in tannin content is not very marked and the results show that the plant could be debarked during the growing season when the operation is comparatively easier.

F.—Drugs

(*i*) *Strychnos nux-vomica* Linn.—A study of the effect of storage on the alkaloidal content of *Strychnos nux-vomica* seeds, began in 1932, was completed and the results published in *Curr. Sci.*, 1947,16 : 346. It was found that during the 16 years of storage in a gunny bag the total alkaloidal and strychnine contents as well as the original silky appearance remained practically unaltered. The previous analyses showed the total alkaloidal content as 2·75 per cent and the strychnine content as 1·20 per cent as compared to the present, 2·70 per cent and 1·17 per cent, respectively. These findings are contrary to the common trade belief (*Chem. & Drugg.*, 1928, 108 : 296) that the seeds on long storage lose the original silky appearance and their alkaloidal content.

G.—Miscellaneous

(*i*) *Monographs* :—

(*a*) *Aromatic Plants of India.*—Four series of the monograph on "Aromatic Plants of India" have been published in the *J. Sci. Industr. Res.* These deal with 24 families from Ranunculaceæ to Geraniaceæ.

(*b*) *Poisonous Plants of India.*—The first volume of the monograph on "Poisonous Plants of India" has been completed and it is hoped that it will be out shortly.

(*ii*) *Inquiries.*—During the year under review, over 400 inquiries were dealt with from Government departments, industrial concerns and private individuals, both producers and consumers of minor forest products, and these dealt with tanning materials, medicinal plants, gums and resins, essential oils, etc. A large number of inquiries sought information on tanning materials, tamarind seed and charcoal kilns. Others solicited information on cultivation, collection, availability, quality and marketing of various minor forest products and the substitutes of those whose supply became short owing to the war and its after-effects. Information on the methods of manufacturing finished products was also supplied.

(*iii*) *List of publications.*—1. Chengappa, B. S., Krishna, S., Badhwar R. L. and Bhargava, M. P., 1947. Survey of India's Forest Resources, A—Timber, Plywood and Veneers, B—Minor Forest Products, C—Cellulose and Paper. *Fifth British Empire Forestry Conference, United Kingdom*, Item 4 (*b*): 10 pages.

2. Krishna, S. and Badhwar, R. L., 1947. Exploitation of Minor Forest Products, (Utilization). *Fifth British Empire Conference, United Kingdom*, Item, 5 (*d*) : 6 pages.

3. Krishna, S. and Badhwar, R. L. 1947. Aromatic Plants of India, Part I. *J. Sci. Industr. Res., India, 6* (2) : Supplement pp. 1—24 (dealing with families Ranunculaceæ, Magnoliaceæ, Annonaceæ, Menispermaceæ and Nymphæaceæ.)

4. 1947. Aromatic Plants of India, Part II, *ibid.*, *6* (3) : Supplement pp. 25–46 (dealing with families Cruciferæ, Capparidaceáé, Resedaceæ, Violaceæ, Flacourtiaceæ, Pittosporaceæ, Polygalaceæ, Caryophyllaceæ and Hypericaceæ).

5. 1947. Aromatic Plants of India, Part III, *ibid.*, *6* (4) : Supplement pp. 47—62. (dealing with families Guttiferæ, Theaceæ and Dipterocarpaceæ).

6. 1947. Aromatic Plants of India, Part IV, *ibid.*, *6* (5) : Supplement pp.63–76 (dealing with families Malvaceæ, Sterculiaceæ, Tiliaceæ, Erythroxylaceæ, Malpighiaceæ, Zygophyllaceæ and Geraniaceæ).

7. Krishna, S. and Rao, P. S., 1947. Tamarind seed polysaccharide. *Curr. Sci., 16* : 256.

8. Puntambekar, S. V., 1947. Substitute for coconut oil in soap industry *Indian Soap J., 13* (6) : p. 119.

9. 1947. Effect of storage on the alkaloidal content of *Strychnos nux-vomica* seeds. *Curr. Sci., 16* (11) : p. 346.

10. Rao, P. S. 1948. The colouring matter of the tamarind seed testa, *Proc. Indian Acad. Sci., 27A* (1) : pp. 52-53.

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CHAPTER XI.

STATISTICAL BRANCH.

The Statistical Branch was brought into existence with effect from August 1,1947. The functions of the Branch as originally conceived were as follows:—

The Statistical Branch will deal primarily with the design of experiment in all Branches of the Forest Research Institute, the subjection of the results to statistical methods of analysis and the assessing of the precision of the results. The Branch will not normally deal with routine computing work. The routine calculating work will continue as hitherto, to be done in the various Branches concerned. The Statistical Branch will also advise all provincial Forest Research Officers in the conduct of their experiments and analysis and interpretation of the results

All technical papers, leaflets, etc., embodying results obtained from experiments designed and statistically analysed by the Statistician will be vetted by him before publication. In the case of experiments commenced before the creation of the Statistical Branch, however, only such technical papers as contain data of a statistical nature will be vetted by him.

Staff.

The technical staff proposed for the Statistical Branch under project 'C' of the Reorganisation Scheme, and the actual staff in employment from 1st August 1947 to 31st March 1948 are given below:—

Post	Proposed staff	Staff during Aug., 1947 March, 1948
Statistician (Officer-in-charge of the Statistical Branch) ..	1	1
Asstt. Statistician	1	..
Head Computors	3	2
Computors	12	5

Dr. A. L. Griffith, I.F.S., Silviculturist, Forest Research Institute was in-charge of the Branch, in addition to his duties, from 1st August 1947 to 28th October 1947 when Dr. K. R. Nair, M.A., M.Sc., Ph.D., was appointed as Statistician on the recommendation of the Federal Public Service Commission.

Advice on design of experiments included.

(1) Preparation of randomized block design for the Chemistry & Minor Forest Products Branch to conduct a manurial experiment on *Ocimum*.

(2) Advice to the Entomology Branch on the lay-out plan of three experiments to be conducted in Bombay Province (*a*) to study the differential effects of 'trimming' and 'not trimming' of leaves of cut bamboo culms, on the starch content and on immunity to insect attack, (*b*) to study the effect of debarking on the incidence of borer attack on four selected species of timber, and (*c*) to study the effect of two different insecticides tried at 3 different strengths on plywood stacked in cubic layers.

(3) Advice to the Silviculturist, East Punjab, on foreign work done to correlate the width of annual rings with rainfall, in connexion with his proposal to start a similar investigation of coniferous crops in the Punjab.

(4) Preparation for the Silviculturist, Central Provinces and Berar, a randomized block design for an experiment on *Eulaliopsis binata* to test the comparative effect, on future growth and yield of grass, by four different treatments (burning *vs* no burning × one cutting *vs* two cuttings in a year).

(5) Preparation of a lay-out plan for an experiment to test the degree of inheritance of twist in *chir* pine (*P. longifolia*) which was proposed to be conducted in 3 localities (Nainital, East Almora & F. R. I. Estate) by the Silviculturist, United Provinces and Silviculturist, Forest Research Institute.

(6) Planning an experiment for Timber Testing Section to determine optimum size of lap joint for testing glue adhesion strength of plywood used for tea-chests.

(7) Advice in the field to the Central Silviculturist on methods of collecting data on germination tests, lay-out of experiments in pots etc.

Statistical Analysis.

(1) The data of the 20 per cent partial enumerations of Dehra Dun Forest division were analysed under Dr. Griffith's supervision while he was in-charge of the Statistical Branch and the results sent by him for publication as Indian Forest Leaflet No. 96 in the series " Efficiency of Enumerations ".

(2) Data of complete and partial forest enumerations done at Ranikhet by students of the Indian Forest Ranger College were scrutinised.

(3) Relation of mean and variability of glue adhesion strengths with size of lap joint in samples of plywood taken from tea-chests was statistically studied on data supplied by Timber Testing Section.

(4) Data of investigations on inheritance of twist in *chir* pine, conducted in Almora division, U. P. were analysed and a report sent to Silviculture Branch.

(5) A report on the statistical analysis of data on strength tests (modulus of rupture) of Bamboo with reference to the influence of seasoning (green *vs* kiln dry), time of felling (May *vs* December), stage of youth (mature *vs* young) section tested (top, middle, bottom) and position of node in the tested piece (node-in-centre and centre inter-node) was sent to Timber Testing Section.

(6) Data on accelerated service tests on timber treated with different creosotes mixed in varying proportions with fuel oil, under full cell, rueping and open tank processes were partly analysed and an interim report sent to the Officer-in-charge, Composite Wood & Wood Preservation Branch.

Discussion with Research Officers.

The Statistician paid periodical visits to the various Branches of the Forest Research Institute, with a view to finding out to what extent statistical methods would assist their research. He addressed the officers at a special meeting of the Institute on Statistical methods in Forest Research. The full text of his talk has been circulated to Provincial Silviculturists and is also being published in the " *Indian Forestor* ".

Vetting of Publications.

Statistician gave his comments on the following articles which were intended for publication :—

(1) Studies on Adhesives Part XII—Cresol-formaldehyde and Cresol-casein-formaldehyde-adhesives for plywood by D. Narayanamurti, V. Ranganathan and O. P. Agarwal.

(2) Glossary of Statistical Terms, by A. S. Rawat.

(3) A further note on constants connecting top height and age for different site qualities in teak plantations by M. S. Raghavan.

Tours.

The Statistician attended the Conference on Standardization and Quality Control held in Calcutta from 8th to 14th February 1948 which was presided over by Dr. W. A. Shewhart, Research Engineer, Bell Telephone Laboratories U S. A. He had several personal discussions with Dr. Shewhart on statistical problems connected with timber research.

CHAPTER XII.

PUBLICITY AND LIAISON BRANCH.

As measure of re-organisation of the Forest Research Institute the organisation of the Utilisation Officer was abolished with effect from 20-5-1947 and the Publicity and Liaison Branch was created to deal with such items of work as were not specifically allotted to other new Branches. Fresh functions were also allocated to the Branch.

The following officers were in-charge of the Branch during the year :—

(1) Rao Saheb B. S. Chengapa, the late Utilisation Officer from 20-5-47 to 30-5-1947.

(2) Dr. K. A. Chowdhury, Wood Technologist from 31-5-47 to 2-7-47 in addition to his own duties during leave of Rao Saheb B. S. Chengapa.

(3) Mr. C. A. R. Bhadran I.F.S., from 3-7-47 to 31-3-48 in addition to the duties of Personal Assistant to President, Forest Research Institute & Colleges and of Director of Forest Education.

As far as information was available (especially in published literature) enquiries were disposed of by the Publicity and Liaison Officer himself : but most enquiries had to be sent to Branches for answers for want of indexed information. Records of enquiries and answers are being kept. Hindi and Urdu translation of Mr. Stewart's appeal (for a new outlook in their work) to the staff on Independence Day were made and distributed widely in the Institute.

No organised visits could be undertaken to other Institutions during the period since May 1947. Incidental to other touring, the Mysore Government Forest Research Laboratory and the Drugs Laboratory at Bangalore were visited as also the Chamarajendra Technological Institution and the Sandalwood Oil Factory in Mysore.

33 publications of different branches of this Institute were sent for printing during the year. Press summaries of the publications (publicity of which was considered necessary) were sent to the Deputy Principal Information Officer, Ministry of Agriculture, New Delhi.

As soon as publications were printed finally they were supplied to various departments in India and abroad on exchange basis. All publications of this Institute are also made available for sale to the public from the Manager of Publications, Civil Lines, Delhi, the Central Library and the Government Agents Messrs Jugal Kishore, Rajpore Road, Dehra Dun.

An innovation was successfully attempted by bringing out a preliminary note on *Broussonetia papyrifera* for the Silviculture Branch by cyclostyling the matter and providing a cover printed in the hand press. For small leaflets this may be adopted on an increasing scale. A bigger effort in this line of work was the bringing out of Branch reports in book form for the Central Advisory Board on Forest Utilisation at very short notice. During the year, the Central Library was transferred to the control of this Branch. All work regarding circulation, transfer and procurement of publications, periodicals and books etc., for all Branch Officers is undertaken by the Central Library.

The Hand Press in the Institute was also transferred to this Branch. So far only labels and forms are printed in it but plans have been taken in hand to enlarge its capacity to some extent.

Circulars have been issued to Provinces and States to send their suggestions for preparing lists regularly of classified information, regarding prevailing prices and rates for major forest products at least once in six months. The question of what particular item of forest products should be considered for undertaking surveys as regards availability etc., in the country is engaging attention.

Exhibits and posters were sent to the All-India Exhibition Calcutta ; some exhibits and posters were supplied to other enquirers. Some new exhibits and posters were also prepared for sending to the Engineering Exhibition Roorkee which was to be held in April 1948 ; but was postponed. Arrangement has been made for reprinting the poster " Stacking of timber for Air Seasoning " in Survey of India Press. Circulars were issued to forest departments in Provinces and States calling for their suggestions for building up representatives forests products sections in Public Museums in important centres in Provinces and States.

In collaboration with the Forest Entomologist, plans are being made for building up a Bird Museum in Forest Research Institute.

Programmes were arranged for visitors to the Institute and as far as possible visitors were shown round personally.

Some exhibits were obtained from Gun Carriage Factory Jubbulpore and Rifle Factory Ishapore and a Burma teak plank of record dimensions from Government Timber Store Bombay for timber museum. Two sets of posters showing work of Forest Research Institute and Colleges were also received from Deputy Principal Information Officer, Ministry of Agriculture, New Delhi. They are displayed in Timber Museum and Silviculture Museum.

Arrangements were made for a Plywood Conference held in July 1947 and for the Central Advisory Board on Forest Utilisation held in March 1948. Training of Forest Officers from Sind, Ceylon and Assam and the Defence Department in Silviculture Forest utilisation and other subjects was arranged in various Branches of this Institute.

Arrangement for training of the following was made :—

(1) Apprentices deputed by Paper Mills in Cellulose and Paper Branch.

(2) Various Military Engineering Service and Army personnel deputed by Defence Department, New Delhi.

(3) Some unpaid apprentices in workshops and laboratories of Wood Working & Timber Mechanics, Wood Seasoning and Wood Technology Branches.

A new electrically driven cyclostyling machine was installed in the Branch. A start has been made with the collection of a film library on forestry subjects. The collection of blocks in the Institute has been regularised under the Silviculturist.

In August 1947, the Publicity and Liaison Officer delivered a course of six lectures of Forestry to the Indian Administrative Service Class at Delhi. The lectures were illustrated with lantern slides etc.

Among the distinguished visitors to the Institute during the year were :—

(1) The Hon'ble Shri Jairamdas Daulatram, Minister for Food and Agriculture, Government of India.

(2) Shri B. R. Sen, Secretary, Ministry of Agriculture, Government of India.

(3) Shri K. W. P. Marar, Joint Secretary, Ministry of Agriculture Government of India.

(4) Members of the Central Advisory Board on Forest Utilisation.

(5) The Hon'ble Shri C. B. Gupta, Minister, United Provinces.

(6) Prof. Alexander Findlay, the British Scientist.

(7) *The Australian Scientific Delegation (leader Sir John Madsen).*

(8) Three officers of the Technical Development Establishment, Kanpur.

(9) Shri S. C. Maitra, Viswa Bharati.

APPENDIX I A

Publications of 1947-48

Title of publication.	Author.	Date of issue.
Indian Forest Records (New Series) (Silviculture).		
A note on the artificial regeneration of the dry fuel forests of the Madras Province—Indian Forest Records Vol. III, No. 8 (Reprint).	A. L. Griffith ..	(In press).
General standard and commercial volume tables for *Terminalia tomentosa*, W and A—Indian Forest Records Vol. 4 A, No. 5.	A. L. Griffith, Bakhshi Sant Ram & Jagdamba Prasad.	Feb. 1948.
(Entomology).		
A list of described immature stages of Indian Coleoptera—Indian Forest Records Vol. 7, No. 5.	J. C. M. Gardner	Feb. 1948.
Indian Forest Bulletins.		
Insect borers of newly felled timber and their control—Indian Forest Bulletin No. 136 (Entomology).	A. H. Khan ..	Feb. 1948.
The afforestation of dry and arid areas—Indian Forest Bulletin No. 133 (Silviculture)—Reprint.	R. L. Badhwar, A. C. Dey & A. L. Griffith.	(In press).
Wood in mechanical and chemical Engineering—Indian Forest Bulletin No. 119 (Utilisation) —Reprint.	D. Narayanamurti.	(In press).
Preservative treatment of bamboos Part I. Treatment of green bamboos with inorganic preservatives—Indian Forest Bulletin No. 137 (Composite Wood and Wood Preservation).	D. Narayanamurti, A Purushotham & J. N. Pande.	(In Press).
The determination of characteristics of soil suitable for sal (*Shorea robusta* Indian Forest Bulletin No. 138 (Silviculture).	A. L. Griffith & R. S. Gupta.	(In press).
Durability trials on glues and plywood—Indian Forest Bulletin No. 139 (Composite Wood and Wood Preservation),	D. Narayanamurti & J. N. Pande.	(In press).
Note on treated wooden transmission poles in India—Indian Forest Bulletin No. 140 (Composite Wood and Wood Preservation).	D. Narayanamurti.	(In press).

APPENDIX IA—*contd.*

Title of publication.	Author.	Date of issue.
Indian Forest Leaflets.		
Derris and other rotenone-bearing vegetable insecticides, their occurrence and possibilities of cultivation in India—Indian Forest Leaflet No. 20 (Chemistry)—Reprint.	T. P. Ghose ..	Feb. 1948.
How to identify timbers. Part V—Timbers for gun and rifle parts—Indian Forest Bulletin No. 50 (Utilisation)—Reprint.	K. A. Chowdhury & K. N. Tandon.	(In press).
Laminated skis—Indian Forest Leaflet No. 79 (Utilisation)—Reprint.	D. Narayanamurti & V. Ranganathan.	Jan. 1948.
The efficiency of enumerations XV. Sal (*Shorea robusta*) forest in Dehra Dun Division of the United Provinces—Indian Forest Leaflet No. 96 (Silviculture).	A. L. Griffith ..	(In press).
Studies on adhesives Part XII—A preliminary note on Cresol-formaldehyde and cresol-casein formaldehyde adhesives for plywood—Indian Forest Leaflet No. 97 (Composite Wood and Wood Preservation).	D. Narayanamurti, V. Ranganathan & O.P. Agarwal.	(In press).
Preliminary studies on improved wood Part IV—Impregnation of wood with urea formaldehyde resins—Indian Forest Leaflet No. 98 (Composite Wood and Wood Preservation).	D. Narayanamurti & J. George.	(In press).
Studies on the storage life of adhesives Part I—Tego-glue film—Indian Forest Leaflet No. 99 (Composite Wood and Wood Preservation).	D. Narayanamurti & J. N. Pande.	(In press).
Studies on adhesives Part X. Adhesives from castor seed cake and its proteins—Indian Forest Leaflet No. 100 (Composite Wood and Wood Preservation).	D. Narayanamurti & G. D. Dagg.	(In press).
Resistance of wood to corrosion by hot chemicals—Indian Forest Leaflet No. 101 (Composite Wood and Wood Preservation).	D. Narayanamurti & V. Ranganathan.	(In press).
Other Publications.		
Forty trees common in India (Reprint)	R. N. Parker ..	(In press).
Triennial Programme of work for the Forest Research Institute, Dehra Dun for 1946-49.	..	(In press).

APPENDIX IA—*concld.*

Title of publication.	Author	Date of issue.
Other Publications—co'd.		
Proceedings of the Seventh Silvicultural Conference, Dehra Dun, October 28th to November 6th, 1946.	..	(In press).
Explanatory notes on forest law.. 3rd Edition (Reprint).	..	(In press).
Forest Research in India and Burma 1940-47. Part I. The Forest Research Institute.	..	(In press).
Manual of General Silviculture for India (Revision).	H. G. Champion & A. L. Griffith.	(In press).
List of seeds offered in exchange	..	Feb. 1948.
Quinquennial Report of the Indian Forest Ranger College, Dehra Dun 1941-42 to 1945-46.	..	(In press).
Progress Report of the Indian Forest Ranger College, Dehra Dun, for the year 1946-47.	..	(In press).
Progress Report of the Indian Forest College, Dehra Dun, for the year 1946-47.	..	(In press).

APPENDIX 1B

CONTRIBUTION TO PERIODICALS IN 1947-48.

General.

Stewart, D.	Short review of current research work on forest products at the Forest Research Institute, Dehra Dun, India. *Fifth British Empire Forestry Conference, United Kingdom 1947.* Item 6B (*b*) Timber Technology.
Stewart, D.	A short note about Mobbs. (*Indian Forester*, Vol. 74, No. 1, January 1948, pp. 31-32).
Bhadran, C. A. R.	(1) Independence Day Celebrations at the Forest Research Institute and Colleges in New Forest (with four illustrations). (*Indian Forester*, Vol. 73, No. 12, December 1947, pp. 523-526).
	(2) Report on the Convocation held on 31st March 1947 of the Indian Forest College (Superior Course) and the Indian Forest Ranger College, Dehra Dun. (*Indian Forester*, Vol. 73, No 10, pages 448-459).
Chengapa, B. S., Krishna, S., Badhwar, R. L. & Bhargava M. P.	Survey of India's Forest Resources, A—Timber Plywood and Veneers, B—Minor Forest Products, C—Cellulose and Paper. *Fifth British Empire Forestry Conference, United Kingdom*, Item 4(*b*), 10 pages.

Chemistry and Minor Forest Products

Krishna, S. & Badhwar, R. L.	Exploitation of Minor Forest Products (Utilisation). *Fifth British Empire Forestry Conference, United Kingdom*. Item 5(*d*), 6 pages.
Krishna, S. & Badhwar, R. L.	Aromatic Plants of India, Part I. *J. Sci. Industr. Res. India*, 6(2) : Supplement pp. 1-21 (dealing with families Ranunculaceae, Magnoliaceae, Annonaceae, Menispermaceae and Nymphaeaceae).
Krishna, S. & Badhwar, R. L.	Aromatic Plants of India, Part II, *ibid.*, 6(3) : Supplement pp. 25-46 (dealing with families Cruciferae, Capparidaceae, Resedaceae, Violaceae, Flacourtiaceae, Pittosporaceae, Polygalaceae, Caryophyllaceae and Hypericaceae).
Krishna, S. & Badhwar, R. L.	Aromatic Plants of India, Part III, *ibid.*, 6(4) : Supplement pp. 47-62 (dealing with families Guttiferae, Theaceae and Dipterocarpaceae).
Krishna, S. & Badhwar, R. L.	Aromatic Plants of India, Part IV, *ibid.*, 6(5) : Supplement pp. 63-76 (dealing with families Malvaceae, Sterculiaceae, Tiliaceae, Erythroxylaceae, Malpighiaceae, Zygophyllaceae and Geraniaceae).
Krishna, S. & Rao, P. S. ..	Tamarind seed polysaccharide (*Curr. Sci.*, 16 : 256).
Puntambekar, S. V.	Substitute for coconut oil in soap industry. (*Indian Soap J.*, 13 (6) : p. 119).
Puntambekar, S. V.	Effect of storage on the alkaloidal content of *Strychnos nux-vomica* seeds (*Curr. Sci.*, 16 (11) : p. 346).

CHEMISTRY AND MINOR FOREST PRODUCTS—*contd.*

Rao, P. S. The colouring matter of the tamarind seed testa. (*Proc. Indian Acad. Sci.*, 27A(1) : pp. 52-53).

ENTOMOLOGY.

Gardner, J. C. M. Larvae of the Noctuidae III (*Trans. R. Ent. Soc. Lond.* 98 : 59-90).

Gardner, J. C. M. A note on the larvae of Trox procerus Har. (Scarabaeidae Col.) (*Indian J. ent.* 5(1) : 31-32).

Gardner, J. C. M. Larvae of Cantharoidea (Coleoptera). (*Indian J. ent.* 8(1) : 121-129).

Gardner, J. C. M. Larvae of Noctuidae IV. (In press).

Mathur, R. N. Notes on the Biology of some Mantidae. (*Indian J. ent.* 8(1) : 89-100).

Mathur, R. N. On the Immature stages of some Psyllidae. (*Indian J. ent.*) (In press).

WOOD TECHNOLOGY.

Chowdhury, K. A. Initial Parenchyma Cells in Dicotyledonous Woods (Nature, Vol. 160, page 609).

Chowdhury, K. A. Some aspects of pure and applied Wood anatomy. (*35th Indian Science Congress, Section of Botany, Patna*, page 1-20).

SILVICULTURE.

Griffith, A. L. Soil Erosion Survey. (*Indian Forester*, Vol. 73, No. 4, pp. 145-154).

Griffith, A. L. Farm Forestry. (*Indian Forester*, Vol. 73, No. 5, pp. 206-211).

Lahiri, K. L. A note on *Araucaria cunninghamii*. (*Indian Forester*, Vol. 73, No. 5, pp. 211-214).

Griffith, A. L. Further notes on aerial reconnaissance for forest officers. (*Indian Forester*, Vol. 73, No. 6, pp. 237-240).

Griffith, A. L. The organisation of post-war silviculture research. (*Indian Forester*, Vol. 9, No. 9. pp. 401-402).

Griffith, A. L. The effect of burning on soil as affecting artificial regeneration. (*Indian Forester*, Vol. 73, No. 12, December 1947).

J. Prasad Pruning in plantation. (*Indian Forester*, Vol. 74, No. 1, January 1948).

J. Prasad Thinning apropos snow damage in *C. deodara* and *P. excelsa* crops. (*Indian Forester*, Vol. 74, No. 2, February 1948).

J. Prasad Congestion of clumps in *D. strictus*. (*Indian Forester*, Vol. 74, No. 2, February 1948).

J. Prasad Silviculture of ten species of bamboo suitable for paper manufacture. (*Indian Forester*, Vol. 74, No. 3, March 1948).

Botany

Bor., N. L. & Raizada, M. B. .. Some beautiful Indian climbers and shrubs. Pt. XXIV. (*Jour. Bomb. Nat. Hist. Soc.* XLVI, (1946), pp. 411-413).

Do. .. Do. Do. Pt. XXV, (*Jour. Bomb. Nat. Hist. Soc.* XLVI (1920), pp. 567-575).

Do. .. Do. Do. Pt. XXVI, (*Jour. Bomb. Nat. Hist. Soc.* XLVII (1947), pp. 1-25).

Do. .. Do. Do. Pt. XXVII, (*Jour. Bomb. Nat. Hist. Soc.* XLVII (1947), pp. 195-196).

Raizada, M. B. Balsa wood. (*Indian Forester*, Vol. 73, No. 4, pp. 155-163).

Bagchee, K. D. An unrecorded parasite of teak reported. (*Indian Forester*, Vol. 73, No. 7, pp. 332-334).

Cellulose and Paper.

Wankhade, O. N. USE OF INDIAN GUAR IN PAPER INDUSTRY (*Indian Pulp and Paper*, Vol. II, No. 3, pp. 149 and 162).

Bhargava, M. P. DEVELOPMENT OF PAPER AND BOARD INDUSTRY IN INDIA. (*Indian Pulp and Paper*, Vol. II, No. Anniversary).

Bhargava, M. P. REQUIREMENTS FOR THE EXPANSION OF THE PAPER AND BOARD INDUSTRY IN INDIA. (*Journal of Scientific and Industrial Research*, Vol. VI B, No. 8, pp. 1-3).

Bhargava, M. P. Review of the Pulp and paper industry in India—A paper for the *Fifth British Empire Forestry Conference, United Kingdom, 1947*).

APPENDIX II

LIST OF PUBLICATIONS OF THE FOREST RESEARCH INSTITUTE, DEHRA DUN

Published up to 31st March 1948

SILVICULTURE SERIES

Indian Forest Bulletins (Old Series)

No.

4 1906. *Ficus elastica*: its natural growth and artificial propagation with a description of the method of tapping the tree and of the preparation of its rubber for the market, by E. M. Coventry. *Out of print.*

5 1906. Visit to some European schools of Forestry, by E.P. Stebbing. *Out of print.*

7 1913. *Chilgoza* forests of Zhob and the Takht-i-Suleman, by E. P. Stebbing. *Out of print.* (Originally published in the entomology series).

9 1913. Influence of forests on the storage and regulation of the water-supply, by S. Eardley Wilmot. *Out of print.*

Indian Forest Bulletins (New Series)

2 1911. Teak plantations in Burma, by F. A. Leete. *Out of print.*

4 1911. Glossary of technical terms for use in Indian forestry, by A. M. F. Caccia and R. S. Troup. *Revised* as *Indian For. Rec.* (n.s.) 2 (1), 1936.

8 1912. Some germination tests with sal seed (*Shorea robusta*), by R. S. Troup. *Out of print.*

22 1913. Causes and effects of the drought of 1907 and 1908 on the sal forests of the United Provinces, by the same author. *Out of print.*

31 1915. Compilation of girth increments from sample plot measurements, by the same author. *Out of print.*

33 1916. Enquiry by the Government of India into the relation between forests and atmospheric and soil moisture in India, by M. Hill. *Out of print.*

41 1921. Weights of seeds, by S. H. Howard. *Out of print.*

45 1921. Miscellaneous forests of the Kumaon Bhabar, by E. A. Smythies. *Out of print.*

46 1921. Rate of growth of Bengal sal (*Shorea robusta*), I quality, by S. H. Howard. *Out of print.*

47 1922. Volume tables and form factors for sal (*Shorea robusta*), by the same author. *Out of print.*

52 1922. Classification of thinnings. Anon. *Revised* as *Indian For. Rec.* (o.s.) 15 (1). 1930.

58 1924. General volume tables for *chir* (*Pinus longifolia*), by S. H. Howard. *Out of print.*

†62 1925. Preliminary yield table for *Dalbergia sissoo*, by the same author. As.0-2-0.

65 1925. Tables for bark deductions from logs, by the same author. *Out of print.*

67 1925. *Chir* (*Pinus longifolia*) seed supply, by the same author. *Out of print.*

1932. Problem of the pure teak plantation, by H. G. Champion. *Revised* as *Indian For., Rec.* (n.s.) 5 (1), 1942.

SILVICULTURE SERIES—*contd.*

Indian Forest Bulletin (New Series)—contd.

*82 1934. Measurement of standing sample trees, by H. G. Champion. Rs. 1-2-0.

*83 1934. Provisional yield table for *Quercus incana* Roxb. (*Banj* or *Ban-oak*), by H. G. Champion and I. D. Mahendru. As. 0-14-0.

*86 1934. Cold weather planting in northern India, by H. G. Champion. As. 0-9-0.

*87 1934. Von Wulfing yield tables for teak plantations in Java, by the same author. As. 0-14-0.

*88 1934. Seasonal progress of height growth in trees, by the same author. As. 0-11-0.

*89 1934. Effect of defoliation on the increment of teak saplings, by the same author. As. 0-3-0.

*91 1935. Damage by frost at New Forest, Dehra Dun, during 1930 to 1934, by Bachaspati Nautiyal. As. 0-12-0.

*106 1942. Control of *Lantana* by a sodium chlorate spray, by A. L. Griffith. As. 0-6-0.

107 1942. Note on *semul* (*Bombax malabaricum* D. C.), by Jagdamba Prasad. *Out of print.*

*130 1946. Effects of burning on the soil as a preliminary to artificial regeneration, by A. L. Griffith. Rs. 1-4-0.

*132 1946. Price-age gradient of Bori. (Hoshangabad, C.P.) teak, by Bakshi Sant Ram. Rs. 1-4-0.

133 1946. Afforestation of dry and arid areas, by R. L. Badhwar, A. C. Dey and A. L. Griffith. Rs. 1-4-0.

*135 1947. Recording of soil and site characteristics in the field, by A. L. Griffith & R. S. Gupta. As. 0-8-0.

*138 1947. Determination of the characteristics of soil suitable for sal (*Shorea robusta*), by the same authors. As. 0-7-0.

Indian Forest Leaflets.

22 1942. Possible wartime sources of vegetable rubber in India, by T. V. Dent. *Out of print.*

*27 1942. Notes on some aspects of erosion control, by Jagdamba Prasad. *Reprinted* 1946. As. 0-8-0.

38 1943. Land-use and erosion, by the same author. *Out of print.*

†60 1944. Short note on the *bedi* leaf industry, by the same author. As. 0-6-0.

†61 1944. Growing of *Cryptolepis grandiflora* as a wartime emergency plantation crop, by A. L. Griffith. As. 0-4-0.

†82 1945. Fodder trees in India, by M. V. Laurie. As. 0-8-0.

†83 1945. Efficiency of enumerations 1.—The problem, by A. L. Griffith. As. 0-4-0.

†84 1945. Efficiency of enumerations 2.—Madras tropical wet ever-green forest 3.—Typical calculations, by the same author. As. 0-8-0.

†85 1945. Efficiency of enumerations 4.—Madras moist mixed deciduous forest, by the same author. As. 0-8-0.

†86 1945. Efficiency of enumerations 5.—Upper Assam tropical ever green forest 6.—Typical calculations, by the same author. As. 0-6-0.

†87 1945. Efficiency of enumerations 7.—Distribution of the volume figures, by the same author. As. 0-6-0.

†88 1947. Efficiency of enumerations 8.—*Chir* (*Pinus longifolia*) forest in the Punjab and United Provinces, by the same author. As. 0-6-0.

SILVICULTURE SERIES—*contd.*

Indian Forest Leaflets—contd.

†89 1945. Efficiency of enumerations 9.—Distribution of the volume figures (*contd.*) by the same author. As. 0-4-0.

†90 1946. Efficiency of enumerations 10. Hill sal (*Shorea robusta*) forest in the United Provinces, by the same author. As. 0-6-0.

†91 1946 Efficiency of enumerations 11.—Distribution of the volume figures (*contd.*) by the same author. As. 0-4-0.

*93 1946. Efficiency of enumerations 12.—One species in a mixed forest (Teak in a Madras moist mixed deciduous forest) 13.—Confirmation of the *chir* (*Pinus longifolia*) and sal (*Shorea robusta*) data 14.—Summary of indications, by the same author. As. 0-5-0.

*94 1946. Classification of silvicultural ledger files (sixth edition). As. 0-6-0.

*96 1947. Efficiency of enumerations XV.—sal (*Shorea robusta*) forest in Dehra Dun division of the United Provinces, by A. L. Griffith. As. 0-3-0.

Indian Forest Memoirs

(N.B —*The part number is indicated within brackets after the volume number*).

1 (1) 1916. *Pinus longifolia* Roxb., A silvicultural study, by R. S. Troup. Rs. 5-0-0.

Forest Pamphlets.

3 1908 Glossary of technical terms for use in Indian forestry, by A. M. F. Caccia. *Revised as Indian For. Rec.* (n.s.) 2 (1), 1936.

5 1909 Sal in Bengal, by A. L. McIntire. *Out of print.*

6 1909. Forest reservation in Burma in the interests of an endangered water supply, by A. Rodger. *Out of print.*

8 1909. Collection of statistical data relating to the principal Indian species, by A. M. F. Caccia. *Out of print.*

9 1910. Table showing the progress in Working Plans in the Provinces outside the Madras and Bombay Presidencies up to 31st December, 1908, by the same author. *Out of print.*

16 1910. Best season for coppice fellings of teak (*Tectona grandis*), by R. S. Hole. *Out of print.*

1 (2) 1908. Preliminary note on the development of the sal in volume and money-value by A. M. F. Caccia. *Out of print.*

1 (4) 1909. 2. Selection system in Indian forests as exemplified in working plans based on this system with a short description of some continental methods, by the same author. *Out of print.*

2 (3) 1910. 1. Silviculture of *Hardwickia binata* (*anjan*), by D. O. Witt. *Out of print.* 2. Notes on *sandal* (Germination and growth of *sandal* seedlings), by M. Rama Rao. *Out of print.*

2 (4) 1911. Host plants of the *sandal* tree, by the same author. *Out of print.*

3 (1) 1911. Some statistical and other information regarding the teak forests of Burma by R. S. Troup. *Out of print.*

3 (2) 1913. Blue gum plantations of the *Nilgiris* (*Eucalyptus globulus*), by the same author. *Out of print.*

6 (2) 1917. Statistics compiled in the office of the Silviculturist, Forest Research Institute, Dehra Dun, during 1915-16. *Out of print.*

SILVICULTURE SERIES—*contd.*

Indian Forest Records (Old Series).

N.B.—*The part number is indicated within brackets after the volume number).*

(5) 1918. Statistics compiled in the office of the Silviculturist, Forest Research Institute, Dehra Dun, during 1916-17. *Out of print.*

7 (8) 1920. Afforestation of ravine lands in the Etawah district, U.P. by E.A. Smythies. *Out of print.*

8 (2) 1921. Regeneration of sal (*Shorea robusta*) forests. A study in economic ecology by R. S. Hole. *Out of print.*

8 (4) 1922. Artificial regeneration in Bengal, by A. K. Glasson and others. *Out of print.*

9 (7) 1923. Possibilities of camphor cultivation from *Cinnamomum camphora* in Northern India, by S. H. Howard and others. *Out of print.*

10 (3) 1923. Sal (*Shorea robusta*) yield table for the United Provinces with an account of the types and distribution of sal forests in the U. P., by E. A. Smythies and S. H. Howard. *Out of print.*

10 (6) 1924. General volume tables for sal (*Shorea robusta*) classified by diameter and height, by S. H. Howard. *Out of print.*

11 (2) 1925. Contributions towards a knowledge of twisted fibre in trees, by H. G. Champion. *Out of print.*

11 (3) 1925. Regeneration with the assistance of taungya in Burma, by H.R. Blandford. *Out of print.*

11 (7) 1925. Volume tables for teak (*Tectona grandis*) and sal (*Shorea robusta*) for the Central Provinces, by V. K. Maitland. *Out of print.*

12 (1) 1925. Volume and outturn tables for sal (*Shorea robusta*), by S. H. Howard. *Out of print.*

12 (4) 1925. Yield table for clear-felled sal (*Shorea robusta*) coppice, by the same author. *Out of print.*

12 (5) 1926. Yield and volume tables for *chir* (*Pinus longifolia*), by the same author. *Out of print.*

12 (6) 1926. Yield and volume tables for deodar (*Cedrus deodara*), by the same author. *Out of print.*

12 (9) 1926. Artificial regeneration in North India, by the same author. *Out of print.*

†13 (3) 1928. Commercial volume tables for sal (*Shorea robusta*) in the wet mixed forests of the Bengal Duars, by Parma Nand Suri. As. 0-6-0.

†13 (4) 1928. Volume tables for *sundri* (*Heritiera fomes*, Buch. Syn. *H. minor* Roxb.) in the Sunderbans, Bengal, by the same author. As. 0-10-0.

†13 (7) 1928. Slash in *chir* pine (*Pinus longifolia*) forests: Causes of formation, its influence and treatment, by J. E. C. Turner. Rs. 3-6-0.

†13 (9) 1929. Volume and outturn tables for blue pine (*Pinus excelsa*, Wall), by H. G. Champion, I. D. Mahendru and Parma Nand Suri. Rs. 1-2-0.

†13 (9) 1929. Commercial timber (*katha*) and heartwood volume tables for *khair* (*Acacia catechu* Willd.) in North India, by the same authors. As. 0-14 0.

†13 (10) 1929. Yield tables for blue pine (*Pinus excelsa*, Wall), by the same authors Rs. 1-9-0.

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*3 (9) 1938. New Indian Curculionidae (Col.), by Sir Guy A. K. Marshall. As. 0-10-0.

*3 (10) 1938. Immature stages of Indian Lepidoptera (1) Lymantriidae, by J. C. M. Gardner. Re. 1-0-0.

*3 (11) 1938. Entomological investigations on the spike disease of sandal (33) Heteroptera Hemipt.), by N. C. Chatterjee. As. 0-8-0.

*3 (12) 1938. Immature Stages of Indian Coleoptera (24) (Curculionidae —contd.), by J. C. M. Gardner. Re. 1-0-0.

*4 (1) 1938 Guide to the insects of *Dalbergia sissoo* for Forest Officers by the Entomological Branch. Re. 1-0-0.

†4 (2) 1941. Guide to the control of termites for Forest Officers, by C.F.C. Beeson. (*Reprinted* 1943). Re. 1-2-0.

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*6 (1) 1939. New Indian Cerambycidae by J. C. M. Gardner. As. 0-6-0.

*6 (2) 1939. Some *Cleridae* from India, Burma and Ceylon with descriptions of new species and notes on others, by J.B. Corporal. As. 0-14-0.

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*6 (5) 1940. New Cerambycidae from India, II (Coleoptera), by W. S. Fisher. As. 0-8-0.

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Indian Forest Records (*New Series*)—concld.)

*7 (1) 1942. Biology of the parasites of the *shisham* defoliators in the Punjab plantations, by R. N. Mathur. Rs. 2-0-0.

*7 (2) 1942. Some Indian Cerambycidae, by J. C. M. Gardner. As. 0-6-0.

*7 (3) 1942. Biology of the Noctuidae (*Lepidoptera*), by R. N. Mathur. Rs. 2-4-0.

*7 (4) 1942. Immature Stages of Indian Lepidoptera (1) Zygaenidae, by J. C. M. Gardner. As. 0-7-0.

*7 (5) 1943. List of described immature stages of Indian Coleoptera, by J.C.M. Gardner. Re. 1-0-0.

*7 (6) 1948. On the plant defoliator-parasite complex in the biological control of teak defoliators, compiled by B. M. Bhatia As. 0-7-0.

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1908. Manual of Forest Zoology for India, by E. P. Stebbing. *Out of print.*

1911. Indian Forest Insects, by E. P. Stebbing. Rs. 3-0-0.

1911. Ecology and control of forest insects of India and the neighbouring countries, by C.F.C. Beeson. *Out of print.*

Miscellaneous Publications.

1926. Explanatory Notes on Forest Law (Third Edition). Rs. 2-2-0.

1913. Surveying and Drawing Manual, by F.A. Brining and D. N. Avasia, *Out of print.*

†1914. Manual of Surveying and Drawing, by J. L. Harrison. Rs. 4-4-0.

1932. Forest College, Dehra Dun, Calendar, 1931. *Out of print.*

†Forest Research in India and Burma 1941-42, Part 1.—The Forest Research Institute. Rs. 1-4-0.

†Forest Research in India and Burma 1942-43, Part 1.—The Forest Research Institute. Re. 2-10-0.

†Forest Research in India and Burma 1943-44, Part 1.—The Forest Research Institute. Re. 3-0-0.

Forest Research in India and Burma, 1944-45, Part 1.—The Forest Research Institute. Rs. 3-8-0.

*Forest Research in India and Burma, 1945-46, Part I.—The Forest Research Institute. Rs. 3-2-0.

*Forest Research in India, 1945-46, Part II.—Reports for Burma and Indian Provinces. Rs. 8-10-0.

*Progress Report of the Indian Forest Ranger College. Dehra Dun, for 1939-40. Re. 1-4-0.

*Progress Report of the Indian Forest Ranger College, Dehra Dun, for 1940-41. Re. 1-8-0.

Progress Report of the Indian Forest College for the year 1939-40. As. 0-12-0.

Progress Report of the Indian Forest College, New Forest, Dehra Dun, for the year 1940-41. As. 0-12-0.

*Quinquennial Report of the Indian Forest College, Dehra Dun, 1941-42 to 1945-46. As. 0-7-0.

*Quinquennial Report of the Indian Forest Ranger College, Dehra, Dun, 1941-42 to 1945-46. As. 0-14-0.

Miscellaneous Publications—(contd.)

*Progress Report of the Indian Forest College, for 1945-46. Re. 1-0-0.

*Progress Report of the Indian Forest College, for 1946-47. Re. 1-4-0.

†1933. The Forest Research Institute, Dehra Dun, Guide. As. 0-3-0.

1941. Annual Return of Statistics relating to Forest Administration in British India for the year 1938-39 with quinquennial review ending 31st March, 1939. Rs. 3-0-0.

1941. Annual Return of Statistics relating to Forest Administration in British India for the year 1939-40. Rs. 2-14-0.

1918. Annual Return of Statistics relating to Forest Administration in British India for the year 1940-41. Rs. 6-0-0.

1915. Classified List of Officers of the Indian and Provincial Forest Service and of the Indian Forest Engineering Service in India on the 1st July, 1914. Rs. 12-10-0.

1947. Classified List of Officers of the Indian and Provincial Forest Service and of the Indian Forest Engineering Service in India on the 1st July 1945. Rs. 7-0-0.

†1929. Malaria in forest area, by Lt.-Col. J.A.S. Phillips. As. 0-2-0.

*1944. Tables showing the cubic contents of round and squared timber and the values of the same at various rates, arranged by L. Mercer, assisted by Nand Mal. (*Reprinted*). Re. 1-14-0.

1. Publications bearing no mark as well as those bearings may be obtained from the Manager of Publications, Civil Lines, Delhi.

2. All publications except those out of print, are obtainable from Messrs. Jugal Kishore & Co., Agents for the sale of Government of India Publications, Rajpur Road, Dehra Dun.

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4. Purchasers not residing in Asia, Africa and Australia should obtain publications from the High Commissioner for India, India House, Aldwych, London, W.C. 2.

APPENDIX III

Statement showing Officers-in-charge of Branches and Sections during the year 1947-48

Branch	Section	Officer-in-charge	From	To
Publicity	..	Mr. B. S. Chengapa ..	20-5-47	30-5-47
		Dr. K. A. Chowdhury ..	31-5-47	2-7-47
		Mr. C. A. R. Bhadran ..	3-7-47	31-3-48
Silviculture ..	..	Dr. A. L. Griffith ..	1-4-47	31-12-47
		Mr. Jagdamba Prasad ..	1-1-48	31-3-48
	Experimental..	Mr. K. L. Lahiri ..	1-4-47	31-3-48
	Statistical ..	Mr. Jagdamba Prasad ..	1-4-47	31-3-48
Statistical ..	..	Dr. A. L. Griffith ..	1-8-47	27-10-47
		Mr. K. R. Nair	28-10-47	31-3-48
Botany	..	Dr. K. D. Bagchee ..	1-4-47	16-12-47
		Mr. M. B. Raizada ..	17-12-47	31-12-47
		Dr. K. D. Bagchee ..	1-1-48	31-3-48
	Mycology ..	Dr. K. D. Bagchee ..	1-4-47 1-1-48	16-12-47 31-3-48
Entomology ..	..	Mr. J. C. M. Gardner ..	1-4-47	15-5-47
		Mr. A. H. Khan ..	16-5-47	13-10-47
		Dr. K. A. Chowdhury ..	14-10-47	28-2-48
		Dr. N. C. Chatterjee ..	1-3-48	31-3-48
	(Systematic Entomology).	Mr. A. H. Khan ..	1-4-47	27-6-47
		Dr. R. N. Mathur ..	28-6-47	31-3-48
Wood Technology ..	..	Dr. K. A. Chowdhury ..	20-5-47	31-3-48
Chemistry & M.F.P.	..	Dr. S. Krishna	1-4-47	6-6-47
		Mr. R. L. Badhwar ..	7-6-47	31-3-48
	M.F.P. Section.	Mr. R. L. Badhwar ..	13-8-47 (A.N.).	31-3-48
Wood Seasoning ..	..	Mr. M. A. Rehman ..	1-4-47	30-12-47
		Dr. S. N. Kapur	31-12-47	9-2-48
		Mr. M. A. Rehman ..	10-2-48	31-3-48

APPENDIX III—contd.

Statement showing Officers-in-charge of Branches and Sections during the year 1947-48—contd.

Branch	Section	Officer-in-charge	From	To
Composite Wood and Wood Preservation.	..	Dr. D. Narayanamurti ..	20-5-47	31-3-48
Wood Working and Timber Mechanics.	..	Dr. S. N. Kapur ..	20-5-47	29-9-47
		Mr. V. D. Limaye ..	30-9-47	29-10-47
		Dr. S. N. Kapur ..	30-10-47	31-3-48
	Timber Testing	Dr. S. N. Kapur ..	1-4-47	3-4-47
		Mr. V. D. Limaye ..	4-4-47	31-3-48
Celluloso & Paper ..	..	S. Chatter Singh ..	20-5-47	9-11-47
		Mr. M. P. Bhargava ..	10-11-47	31-3-48

APPENDICES.

APPENDIX IV

Annual Form No. 24

FOREST RESEARCH INSTITUTE

Summary of Revenue and Expenditure during 1947-48

Budget Heads	Direction.	Botany Branch.	Silviculture Branch.	Entomology Branch	Bio-Chemistry Branch	Publicity Branch.	W.W and T.M. Branch.	C.W. and W.P Branch.	C. & P. Branch.	W. S. Branch.	W T. Branch.	Statistical Branch	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Rs.	Rs	Rs.	Rs	Rs	Rs.	Rs.	Rs.	Rs.	Rs	Rs.	Rs.	Rs.
REVENUE.													
Miscellaneous	13,312	5,018	11,651	1,127	67	616	16,083	199	2,296	575	2 012	..	53,056
(a) Fines and forfeitures	7	..	..	..	..	..	..	..	..	..	..	.	..
(b) Leave contribution of officers on foreign service	..	..	..	..	..	..	..	..	..	..	..	..	..
(c) Other sources	..	..	.	..	..	..	..	..	..	..	..	..	..
(d) Sale of timber and furniture from Seasoning and Wood Workshop depot.	..	..	..	..	..	..	67	..	..	..	..	..	67
Total Revenue ..	13,412	5,018	11,651	1,127	67	616	16,150	199	2,296	575	2,012	..	53,123
EXPENDITURE													
1—Pay of officers—													
(a) Superior officers .. (Non-voted) ..	22,100	..	7,500	11,813	..	1,150	..	..	..	..	..	..	42,563
(b) Superior officers .. (Voted) ..	33,681	23,294	31,024	14,912	29,036	11,098	38,749	21,961	17,885	9,014	10,183	2,893	2,00,224
2—Pay of Establishment	68,285	14,471	33,326	25,018	16,234	13,826	74,485	11,907	12,721	14,569	9,389	7,372	3,01,084
3—Allowances—													
T.A and Other Allowances (Non-voted) ..	1,093	..	2,738	1,324	..	351	..	..	..	..	..	..	5,506
T. A and Other allowances (Voted) ..	47,404	15,030	31,975	18,780	17,026	11,153	48,748	15,232	14,873	12,436	9,179	4,030	2,47,066
4—Purchase of stores, tools and plants ..	2,693	2,471	3,302	11	25	45	2,050	1,856	317	202	621	8,804	22,457

A.6—Communication and buildings repairs and maintenance.	..	..	..	..	..	..	..	..	..	..	..	..	..
A.6—Charges in connection with Indian Paper Makers Association.	..	..	..	..	..	..	..	..	6,713	..	..	..	6,713
A.7—Other charges—													
Temporary Establishment on daily labour..	12,730	22,070	18,629	5,169	3,780	740	27,359	3,017	9,840	6,847	1,076	..	1,11,557
Purchase of timber for seasoning and preservation including freight and cartage.	..	..	80	3	..	..	5,731	1,004	..	3,122	217	..	10,157
Purchase of coal, raw material chemical and apparatus.	1,020	1,117	184	60	3,111	25	10,023	6,780	1,370	329	2,010	5,208	35,206
Other charges	5,959	2,370	696	143	1,998	1,537	13,065	1,500	2,936	1,717	2,648	75	34,734
Supplies, service and contingencies—													
(a) Stationery	238	28	32	..	..	230	46	21	10	18	12	34	669
(b) Carriage of tents and records ..	259	785	1,036	530	17	..	368	106	11	141	15	..	3,268
(c) Rents, rates and taxe	6,170	124	80	2	148	64	63	..	599	..	..	.	7,355
(e) Official postage	3,507	297	285	155	304	916	335	124	352	60	375	88	7,188
(f) Sundries	20,523	1,488	1,194	374	487	5,107	1,772	193	665	637	341	202	44,983
(g) Clothing and uniforms ..	6,443	..	..	..	..	..	..	..	..	..	..	..	6,443
(h) Telephone charges	2,186	396	402	162	468	..	1,044	108	180	160	..	180	5,306
Cost of passage granted under Superior Civil Services Rules, 1924—Non-voted (to be adjusted by A. G. C. R.).	972	..	972	201	..	..	..	..	..	..	..	..	2,145
Total A.7 ..	59,367	28,975	28,595	7,105	10,326	8,649	59,806	13,243	19,963	13,031	7,294	5,847	2,60,221
Grand Total of all expenditure under 10—Forest.	2,44,622	84,841	1,40,360	81,968	73,847	46,272	2,23,838	67,289	71,472	49,272	45,654	29,003	11,28,439
Major head R. A. Share of Capital charges financed from ordinary revenue.	..	..	..	..	..	..	..	..	..	..	..	..	..
Surplus or deficit ..	2,31,211	79,823	1,28,709	80,841	73,780	45,656	2,07,688	..	69,176	48,697	43,612	29,003	11,08,316

Note.—The figures in the statement do not include certain adjustments to be made by the Accountant General, Central Revenues, New Delhi, in March final 1941 accounts on account of exchange accounts with other Government departments.

M10FRIDDun 300—2-2-50—GIPS